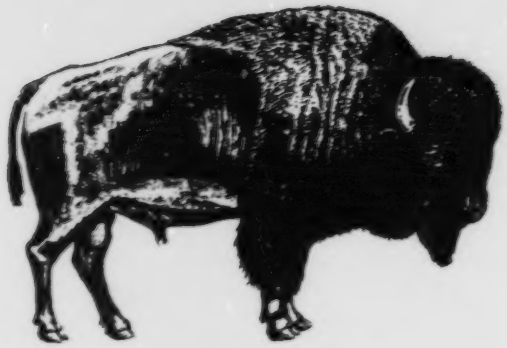
NORTHERN DISEASED BISON

ENVIRONMENTAL ASSESSMENT PANEL



COMPENDIUM OF GOVERNMENT SUBMISSIONS &

TECHNICAL SPECIALIST REPORTS IN RESPONSE TO

THE PANEL INFORMATION REQUIREMENTS DOCUMENT

October, 1989

Federal
Environmental
Assessment Review
Office

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Deputy Minister
Health and Welfare Canada

Sous-ministre
Santé et Bien-être social Canada

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F.E.A.R.O.
B.F.E.E.E.
File/ Réf:

REC'D / REÇU

SEP 25 1989

Your file / Votre référence

Our file / Notre référence

Mr. R.G. Connelly
Chairman
Northern Diseased Bison
Environmental Assessment Panel
Federal Environmental
Assessment Review Office
Fontaine Building, 13th Floor
HULL, Quebec
K1A 0H3

Dear Mr. Connelly:

Thank you for your letter of July 27, 1989, in which you provided a copy of your Panel's "Information Requirements" needed for the review of the problem of diseased bison. The Executive Secretary of your Panel, Mr. Colin Lachance, wrote separately on July 11, 1989 to Mr. Maurice Aked, Regional Director, Medical Services Branch, Alberta, providing an advanced copy of the questionnaire.

A response prepared by our Regional staff in Alberta is attached for your information. I trust that this will be helpful.

I wish to advise you of my continued interest in the work of the Assessment Panel and I shall be pleased to hear further of its work in the future.

Yours truly,

Margaret Catley-Carlson

Enclosure

Ottawa K1A 0K9 Ottawa K1A 0K9

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Your file Votre référence

Our file Notre référence

September 12, 1989

Mr. Colin D. Lachance
Executive Secretary
Northern Diseased Bison
environmental Assessment Panel
Federal Environmental Assessment Review Office
510 - 750 Cambie Street
Vancouver, B.C.
V6B 2P2

Dear Mr. Lachance:

Re: **Information Requirements - Diseased Bison Environmental Assessment Panel**

In response to your request for input from our Department on the Information Requirement questionnaire, please be advised of the following:

Section 3.0 Current Status

Question 3.1

Given the extended period of time the diseased Bison have been in the Wood Buffalo National Park Area one would expect that there would be sporadic outbreaks of brucellosis and/or bovine tuberculosis in the hunters and trappers or visitors to the National park. This has not been the case and extensive review of our records has revealed that there has not been a single confirmed case of either disease that could be traced to the herd.

Nonetheless a potential for disease transmission to humans does exist and in fact the potential may increase if the park is successful in attracting more tourists to the area.

If the status quo option was implemented, and the existing free roaming herd was to be maintained, our office would pursue the following strategy:

... 2

1) Develop information pamphlet that would be distributed to all visitors to the park. The pamphlet would outline the primary characteristics and etiology of each disease, the mode of transmission, the risk or potential of transmission to humans and the safeguards to follow to avoid contracting the illness.

2) A similar but more specific pamphlet would be developed for distribution to hunters and trappers. These pamphlets would have to be in English, French and Cree.

3) Education Sessions would be planned with input from the various hunter and trappers associations that exist in the risk area.

4) Finally, to fulfill our responsibility of carrying out Treasury Board's Occupational Health and Safety policy we would have to ensure the health of federal public servants employed in the park is protected. This would involve reviewing handling procedures for diseased animals and carcasses, providing education sessions on the diseases in question and ensuring safety precautions are taken to minimize the risk of disease transmission.

Question 3.2

Given the incidence of disease transmission in the past we would expect a high degree of success.

When new variables are introduced such as further migration of the herd outside of the park boundaries, increased incidence of disease in the bison herd and increased tourism in the Park, the potential for disease transmission to humans also increases. With this in mind we suspect our strategy will be effective in the short term but less effective in the long term when attitudes are relaxed as a result of low incidence of disease transmission following an extended period of exposure to the diseased herd.

Question 3.3

Costs to government include printing costs for educational pamphlets and travel and human resource costs associated with providing education seminars.

A rough estimate of these costs are as follows:

a) Pamphlet Design and Development	$ 4,000.00
x 2 (i.e. two separate target groups)	
Total	$ 8,000.00
b) Printing (annual cost).....	$ 2,000.00
Total	$10,000.00

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c) Travel Cost (annual)..... $ 8,000.00/year

d) Total First Year Cost..... 18,000.00
Reoccurring Cost..... 10,000.00/year

e) Manpower Costs

Pamphlet development	15 days
Education Sessions	20 days
Total first year	35 days
Reoccurring expenditure	20 days

Question 3.4

The social and economic costs associated with both brucellosis and tuberculosis is related to the long recovery period associated with each of the illnesses. In the case of Brucellosis or undulent fever, the illness has been known to last for several days, months or sometimes a year or more. Part or all of the original syndrome may appear as relapses, especially on re-exposure.

Tuberculosis treatment requires that a patient follow a prescribed chemotherapeutic regimen for about twelve months. Infected persons may return to work however following sputum conversion when sputum tests negative.

From the socio/economic perspective of the infected person, there may be an extended period away from work and in the case of tuberculosis there is an opportunity for a person to person transmission of the disease to other members of the household. This is particularly true in native households where overcrowding is prevalent.

Question 3.4.1

The cost of a disease outbreak to the government health care system would be high. Experience in treating tuberculosis on reserves in Alberta suggest that a person with active tuberculosis would require a one month stay in hospital at a cost of $ 800.-1000. dollars a day. Follow up would require a public health nurse to visit a patient 2-3 times per week for 9 months to a year to insure the patient is complying with the chemotherapy.

The length of hospital stay and the amount of follow up necessary to ensure compliance with chemotherapy may be reduced if the illness is not severe and social circumstances make treatment at home possible.

...4

Another area of high cost that might evolve as a result of disease outbreak would be government response to requests for extensive community surveys from native leaders. Native leaders may want to have all members of their community tested for presence of these diseases should an outbreak occur. It should also be noted that these requests may surface irrespective of weather an outbreak has occurred.

Question 3.5

I am not sure if Health and Welfare is the agency that should be responding to questions relating to tourism but I would expect that a disease outbreak in humans would have negative impact on tourism in Wood Buffalo National Park. The degree of impact would depend upon the extent of the outbreak and the amount of press the incident received.

Interim Protection Measures

Question 4.1.1

Interim risk reduction measures would be the same as those adopted for the option to maintain the status quo. If a short disease elimination period was anticipated, Health and Welfare would want to re-evaluate the benefits of developing information packages or brochures and possibly limit our involvement to educational seminars. This interim approach would result in a $10,000.00 cost saving from previous estimates.

In regard to locations it would appear that educational sessions would have to be held in Ft. Smith for both the Parks Canada Staff and the Hunters and Trappers Association. Other communities in which educational seminars would be held would include Ft. Chipewan, Peace Point, Garden River, Fox Lake and John D'Or.

Question 4.1.2

As indicated earlier it is anticipated that the interim measures put forward by Health and Welfare will have a high degree of success. The reason being that during the fifty (50) or more years the diseases have been prevalent in the Park we have not had a single reported case that could be traced to the bison in Wood Buffalo.

Question 4.1.3

Total cost without brochures would be $ 8,000.00 annually and 20 person days. If the disease elimination period was extended over a long period of time it would cost another $2,000.00 per year in printing costs. First year costs were outlined earlier in comments relating to section 3.

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Question 4.2.1

If the fencing option were implemented Health & Welfare would restrict activities to protection of federal public servants working in the Park. This would probably involve one educational seminar per year.

Question 4.3.1.4

Medical Services Branch would require that all meat saved for human consumption be inspected and approved by Agriculture Canada Meat Inspection Division. Following processing the meat storage and distribution network would have to meet the requirements of provincial Health Regulations and Alberta Agriculture regulations. If the meat storage facilities were on federal lands or if the primary target group for the meat was native people, Medical Services Branch would inspect meat storage and distribution facilities to ensure minimum health requirements were met (i.e. Provincial Health Regulations)..

The threat of occupational disease is also prevalent when processing diseased animals. Therefore, Medical Services Branch would be involved in evaluating the facilities, processes, procedures and personal protective equipment requirements to ensure federal public servants working in all stages of the processing operation are adequately protected.

If you have any questions or require further clarification of any matter raised in this letter please feel free to give me a call at 495-5601.

Arthur J. Murphy
Regional Environmental Health Officer
Prairie Region

AM/jg

cc: Mr. Aked
Regional Director
Alberta

Mr. Normand Turcotte
Director
Occupational & Environmental Health
Prairie Region

8

Agriculture Canada

Deputy Minister
Ottawa, Ontario
K1A 0C5

Sous-ministre
Ottawa (Ontario)
K1A 0C5

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F.E.A.R.O.
B.F.E.E.E.
File: Ref:
SEP 19 1989
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Please Quote: ~~EMC 36026~~

SEP 15 1989

Mr. R.G. Connelly
Chairman
Northern Diseased Bison Environmental
Assessment Panel
Federal Environmental Assessment Review Office
Fontaine Building, 13th Floor
Hull, Quebec
K1A OH3

Dear Mr. Connelly:

Thank you for your letter of July 27, 1989, concerning the Northern Diseased Bison Environmental Assessment Panel, and the "Information Requirements" developed by the Panel as a result of scoping workshops.

The questions relating to the northern diseased bison issue that have been directed to Agriculture Canada, as a result of our mandate and jurisdiction, are being responded to by my officials. Dr. W.S. Bulmer, Director, Animal Health Division will be forwarding the response to your office by September 15, 1989. I am concerned that the review process can proceed on schedule.

I look forward to hearing the results of the Panel's deliberations. If you require additional information, please do not hesitate to contact me.

Yours sincerely,

Jean-Jacques Noreau

Canada

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Agriculture Canada

Food Production and Inspection Branch

Direction générale
Production et inspection des aliments

RECEIVED

Ottawa, Ontario
K1A 0Y9

Your file / Votre référence

October 3, 1989

Our file / Notre référence

Mr. Colin Lachance
Executive Secretary
Northern Diseased Bison
Environmental Assessment Panel
510-750 Cumbie Street
Vancouver, British Columbia
V6B 2P2

Dear Mr. Lachance:

Enclosed is a copy of the proposal which Agriculture Canada submitted to the EARP panel on September 15, 1989. It has been amended on pages 14, 15, 16, 17 and 18.

Please advise if you require more information.

Yours sincerely,

W.S. Bulmer
Director
Animal Health Division

Canada

RECEIVED
OCT 10 1989
FEARO PACIFIC

A PROPOSED COURSE OF ACTION TO REPLACE DISEASE EXPOSED BISON IN NORTHERN CANADA WITH DISEASE-FREE WOOD BISON

The following agencies contributed informationm to and assisted in the preparation of this document - at the request of Agriculture Canada.

Alberta Agriculture, Alberta Fish and Wildlife, Northwest Territories Renewable Resources, Canadian Wildlife Service.

October 2, 1989

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** In this paper the term disease exposed Park bison refers to bison in and near Wood Buffalo National Park of uncertain genetic affinity which are considered exposed to brucellosis and tuberculosis (not necessarily infected).

1. INTRODUCTION

The purpose of this document is to re-examine the Wood Bison Recovery and Disease Eradication option as outlined in the "Evaluation of Brucellosis and Tuberculosis in Bison in Northern Canada", produced by the Bison Disease Task Force.

The objective was to develop alternatives within the disease eradication option. It was initially suggested this would involve short, medium, and long-term time frames.

After several lengthy and involved discussions it became evident that three distinct time frames could not be identified.

The course of action proposed in the following pages is meant to be a discussion document. It is believed that this proposal is both feasible and workable. It is desired that the report will generate further ideas on how to better proceed with the replacement option. Needless to say, some modifications are expected, especially in view of local participation and involvement. Constructive criticism from all sincere individuals and groups is most welcome.

2. DEPOPULATION

The removal of 4,000 - 5,000 disease-exposed bison from Wood Buffalo National Park and the surrounding area will be a difficult job. A number of logistical problems to depopulation have been identified. However, it is believed that the task can be completed efficiently and in a manner that will satisfy most of the questions raised so far.

First, it will be necessary to secure enough land for construction of an abattoir/cold storage facility for processing bison in the Fort Smith area. The abattoir should be built to Agriculture Canada Standards, to accommodate Federal Inspection for meat processing and packaging. Consideration is being given to shipping condemned material and carcasses to facilities in Alberta which have large capacities and are under Agriculture Canada's supervision. Once the depopulation phase is completed, the abattoir facility could be turned over to the Government of the Northwest Territories for use by local bison ranching groups.

It is most desirable that the meat inspection all be done to Federal Standards, however, this may not be entirely possible. The depopulation plans also include portable slaughtering facilities which do not meet the Federal Standards. While such a facility makes removal of Park bison from the Peace-Athabasca delta much easier, it restricts the sale of the meat and by-products to either Alberta or the Northwest Territories. It is further acknowledged that supervised controlled hunting will have to be used to remove bison from some areas.

To assist with this depopulation, suitable holding facilities will have to be built. Two already disturbed areas in Wood Buffalo National Park would be suitable, namely Sweetgrass and Hay Camp. The Peace-Athabasca delta area contains the largest concentration of disease-exposed bison within the Park.

Baiting bison with hay has been used successfully in winter months in Elk Island National Park and northern Alberta. This method should be attempted, to capture disease-exposed bison in the two Park holding facilities at Sweetgrass and Hay Camp. In addition to baiting with hay, consideration should be given to using the most recent observations of bison migration patterns, the use of wing fences on the corrals, snow-ploughed trails, and controlled hazing using air and ground techniques. It has also been suggested that darting a group of dominant cows and the addition of radio collars in year zero, would assist in observing the migration patterns, and in locating major groups of Park bison in the delta. Below is a chart of the numbers that could be expected to be taken out of the Peace-Athabasca delta each year, and the slaughter method which will be used.

	Trapped Live & Moved to Fort Smith Abattoir	Processed Through a Portable Abattoir	Controlled Hunting	Total
Year 1	800 - 1200	400 - 500	300 - 400	1500 - 2100
Year 2	600 - 1000	300 - 400	200 - 300	1100 - 1700
Year 3	400 - 800	200 - 250	100 - 150	700 - 1200

It is estimated that approximately 24 km of winter road will have to be built, so that bison corraled at the Sweetgrass area can be transported to Fort Smith for processing. There is approximately an 80 day period during which the road transportation method will be feasible, by using an ice bridge across the Peace River. The shipping season could be extended by the use of barges on the Peace and Slave rivers if necessary.

During the time when disease-exposed bison are being removed from the Peace-Athabasca delta area, it will be essential to start depopulation in remote areas of the Park. Depending on accessability it may not be feasible to salvage some carcasses. In more accessable areas, some inspected carcasses may be made available to local communities if they want them.

Depopulation must be complete prior to the release and reintroduction of disease-free wood bison into the wild in Wood Buffalo National Park. This will necessitate extensive aerial surveillance during the winter when spotting is easier. It is proposed that four consecutive years of aerial reconnaissance without bison sign will be considered reliable to determine that depopulation is complete. Although a precise time frame cannot be predicted for depopulation, it must be completed as quickly as possible.

Wood Buffalo National Park should not without bison of some kind for any great length of time. Therefore, while capture corrals are being constructed at Sweetgrass and Hay Camp, large 100 square km double-fenced compounds need to be built around or adjacent to these facilities. These compounds can be used to maiantain disease-exposed bison initially, pending removal to Fort Smith. After being vacant for a season (one summer at least) they can be used to hold wood bison replacement stock. The double fencing would ensure that no strays (disease-exposed bison) could contact the wood bison stock and spread disease. It will be necessary to determine if removal of the Hay Camp and Sweetgrass facilities will be required once bison are released into the Park.

There is considerable concern over the disposition of meat and by-products from an operation in which large numbers of disease-exposed bison are slaughtered. Close liaison must be maintained with existing bison marketing groups so that the existing domestic market won't be seriously affected.

A large percentage of the carcasses are expected to be of poor quality. Carcasses of lesser market quality could be processed for mink and dog food. Carcasses that are fit for human consumption can be made available to local communities and for commercial sale on the Canadian, U.S., or European bison meat markets. Hides, capes and heads can be handled through conventional markets. Any revenues from the sale of any bison meat or by-products should be directed into a trust fund that is set up for the enhancement of wood bison recovery or improving the bison ecology in Wood Buffalo National Park.

3. DISEASE-EXPOSED BISON REPLACEMENT

The proposal for replacement with disease-free wood bison has three objectives. First, it is necessary to ensure that Wood Buffalo National Park maintains a viable population of disease-free wood bison. Second, it is desirable to establish another herd of disease-free wood bison to assist with the removal of wood bison from the endangered species list. And third, it is desirable to develop the Hanging Ice Bison Ranch into a viable operation. Once this occurs restocking of the Slave River Lowlands with disease-free wood bison would be possible which would provide Native people with more opportunities to hunt in their traditional way.

The wood bison repopulation phase of Wood Buffalo National Park, will require the use of corrals and double fenced compounds built at Sweetgrass and Hay Camp. However, these facilities must remain vacant for one year after housing disease-exposed bison before place disease-free wood bison in them.

While corrals and enclosures are being built at Sweetgrass and Hay Camp, corrals and small (10 square km) double-fenced enclosures should be built at **Hook Lake and in the area of the **Proposed Hanging Ice Bison Ranch. Negotiations should begin immediately with the proponents of the Hanging Ice Bison Ranch to indicate support for their project, potential financial assistance and a request for their assistance to develop a wood bison breeding facility suitable for use in the replacement option. These facilities would be turned over to the Government of the Northwest Territories to assist in the development of a viable bison ranching business once the replacement option is completed. A key to the repopulation scheme is the use of the Hanging Ice Bison Ranch and the Hook Lake corral (an already disturbed area) as breeding and holding facilities for disease-free wood bison stock (Elk Island National Park and Mackenzie Bison Sanctuary). Wood bison produced in the two Slave River Lowlands enclosures will be moved to Park enclosures as soon as it is feasible and safe to do so. If the Hunters and Trappers Association of Fort Resolution are interested in bison ranching as a viable means to their life style, the Hook Lake Facility could be turned over to them by the Government of the Northwest Territories. Regardless this facility is required as part of the repopulation plan and would be a necessary part of a genetic salvage sub-option.

The wood bison replacement stock in Wood Buffalo National Park must be increased in a rapid manner. Stock from the Hanging Ice Bison Ranch and the Hook Lake breeding facilities are to be used in addition to continuous supplements from Elk Island National Park and the Mackenzie Bison Sanctuary. This herd is to be increased as rapidly as possible so that the Park will be able to display bison during the replacement phase.

**See Appendix III

The two double fenced enclosures in the Park are to be large enough to sustain a large herd of bison without supplementary feeding, although a supply of native hay from nearby meadows should be prepared and available in case of emergencies.

All wood bison entering Park enclosures are to be brucella and tuberculosis tested before being release into the facilities. In addition, every animal should be vaccinated against anthrax at the time of testing. All animals entering Park compounds must be positively identified and tagged.

Following depopulation bison would not be available in the Slave River Lowlands. Bison meat from other sources could be made available to local people. The meat source could be surplus stock from the Hanging Ice Bison Ranch or the Hook Lake breeding facilities, or it could be plains bison meat from commercial herds.

It is anticipated that with good management and freedom from disease problems, an increase in the number of breeding herds of wood bison will occur to the point where removal from the list of endangered species will be possible.

The carrying capacity of Wood Buffalo National Park should approximate at least 9,000 animals based on survey information from 1972. The Slave River Lowlands (including captive herds at Hanging Ice Bison Ranch and Hook Lake) should support about 3,000 head. The Mackenzie Bison Sanctuary is likely to support approximately 3,000 head, and the range in northern Alberta could support approximately 3,000. Once established, herds of these sizes in the Slave River Lowlands and northern Alberta could support harvesting at the rate of about 10% per year or approximately 500 bison per year that would be available for hunting. There appears to be a potential to increase the total numbers of wood bison in northern ranges in and around Wood Buffalo National Park to approximately 15,000 animals once the depopulation and replacement phases are completed.

4. TIMETABLE FOR REPLACEMENT OPTION

YEAR 0

Complete phenotypic assessent of existing bison in the Park and Slave River Lowlands, if required. Genetic assessment must be completed prior to commencement of a salvage operation.

Start to test baiting of bison with hay.

YEAR 1

1. Start building corrals at Hook Lake (1 square km.) Start building corral at Hanging Ice Bison Ranch (1 square km), if not already underway. Also, start building corrals at Sweetgrass, Hay Camp, and the Mackenzie Bison Sanctuary,(one square km each).

2. Test feasibility of baiting bison with hay into a corral system (winter only).

3. Start building slaughter, storage and rendering facilities at Fort Smith. (See Appendix II).

4. Start building fenced enclosures (100 square km each) at Sweetgrass, Hay Camp and Mackenzie Bison Sanctuary, and (10 square km each) at Hanging Ice Bison Ranch and Hook Lake.

5. Build 24 km of road needed between Sweetgrass and Fort Smith so captured bison can be trucked to Fort Smith for slaughter. Also, additional roads may be built to Hanging Ice and Hook Lake sites.

YEAR 2

1. Complete abattoir and storage facilities at Fort Smith.

2. Start field slaughter of bison in remote areas during the winter; for example, the areas in the northwest and southwest corners of Wood Buffalo National Park, as well as adjacent areas in Alberta.

3. Start transfer of disease-free wood bison to the Hanging Ice Bison Ranch.

4. Start roundup activities by hay baiting bison into Sweetgrass and Hay Camp corrals.

5. Establish hay storage depot in Fort Smith (on abatttoir property).

YEARS 3 - 8

1. Add a total of 130 - 150 disease-free wood bison to Hanging Ice and Hook Lake holding facilities each year. In addition, direct stocking of Park enclosures can occur. This assumes agreements can be made with Government of the Northwest Territories for 90 - 100 per year from the Mackenzie Bison Sanctuary and with Elk Island National Park for 40 - 50 per year.

2. Begin slaughter of disease-exposed bison from the sweetgrass and Hay Camp areas. Transfer any captured bison to the abattoir in Fort Smith for disposal.

3. Continue field slaughter in remote areas, including Slave River Lowlands.

4. All removal to be done in as short a time frame as possible.

NOTE: Sweetgrass and Hay Camp corrals and enclosures need one summer "empty" before reintroduction of disease-free wood bison from Hanging Ice or Hook Lake breeding corrals.

5. ENVIRONMENTAL IMPACTS

Potential environmental impacts have been raised as concerns by local and environmental groups. The following are some environmental impacts that have been considered:

a) Vegetation Succession:

Vegetation succession is a natural on-going process in all natural ecosystems. The number of bison in the Slave River Lowlands is declining and unless something is done in the near future, this population could cease to exist within the next few years. The total removal of natural grazing will certainly accelerate vegetation succession in the area. Vegetation succession in the Slave River Lowlands is already occurring. It is not likely that the estimated 200 bison remaining in the area will prevent advancement of woody growth.

The Peace-Athabasca delta area is also changing, possibly more from the effects of the Bennett Dam causing the area to dry out, than from reduced grazing pressure because of declining bison herds. Howver, depopulation of disease-exposed bison in the area is likely to cause an acceleration in the succession rate, but repopulation will cause a decline in the succession rate as populations of free-roaming wood bison increase. Controlled burning or artificial flooding may be useful in manipulating succession if deemed necessary.

b) Predators:

The Northern Disease Bison Environmental Assessment Panel has hired a consultant to assess the effects of bison removal on the predator-prey relationship. It has been observed in the Mackenzie Bison Sanctuary that the predator levels change rapidly according to the available food supply. It is assumed that while depopulation of the bison will likely affect predator levels, it is anticipated that these levels will again adjust when repopulation with wood bison takes place.

c) Other Ungulates and Prey Species:

Moose exist in low densities in Wood Buffalo National Park and the Slave River Lowlands. Some woodland caribou range in the Caribou Mountains on the west edge of the Park. No barren ground caribou have been sighted in the Park for many years. The deer population is quite low and thought to be itinerant.

Therefore, it is assumed that there will be a minimal effect on other ungulates because of their low densities and use of different ranges.

d) Others Species:

Few beaver exist in the Park at the present time although this low density may be on the increase.

The wolf population at the present time is high and wolves are known to occasionally prey on beaver and muskrats. However, the impact of wolves on these other prey species is not believed to be seriously detrimental to those populations.

The fox population is thought to be high at present but concern regarding them as carriers of rabies is greater than that as a significant predator of bison. As wolves decrease and available bison carrion disappears, the ox population may decline but this is not anticipated to be detrimental to their survival.

6. MANAGEMENT PROPOSAL - COMPENSATION AND COSTS

1. Replacement of disease-exposed bison with wood bison in and around Wood Buffalo National Park is the recommended course of action.

2. A number of corrals and enclosure facilities are needed to complete this task.

   a) Construct two large corrals (one square km each) with adjacent double-fenced 100 square km enclosures at Sweetgrass and Hay Camp in Wood Buffalo National Park in areas that are already disturbed.

      1. Use corrals for capture and holding disease-exposed bison from the Park until shipment to Fort Smith for slaughter.

      2. When the area is depoplated these facilities can be used (after 1 year being empty) to maintain and breed disease-free wood bison for eventual release into the Park as part of the repopulation.

      3. Both the Sweetgrass and Hay Camp facilities could act as display areas for the Park. If Canadian Parks Servicea requests, construction of a modest sized double-fenced display corral for disease-free wood bison could be considered in an alternate area in the Park that is more accessable to the public.

   b) Construct two corrals that are one square km each with 10 square km double-fenced enclosures at Hanging Ice Bison Ranch and Hook Lake. These enclosures should be large enough to reduce the amount of care and supplementary feeding required. These two enclosures will be used to maintain disease-free wood bison initially transferred from Elk Island National Park and the Mackenzie Bison Sanctury. The Hook Lake facilities could be used for the genetic salvage of wood bison from Wood Buffalo National Park and the Slave River Lowlands if necessary. (See Appendix I). The second facility in the Slave River Lowlands is required for several reasons. If it is decided that genetic salvage of some of the Slave River Lowlands and/or Park bison is necessary, the facility at Hook Lake will be used to maintain those animals for at least ten (10) years or until it is determined that third generation offspring are disease-free. Another wood bison herd of over two hundred (200) head would be desirable in assisting with the removal of the wood bison from the endangered species list. This herd could also be used to restock the Slave River Lowlands with a disease-free wild population.

c) Construct a large corral (one square km) and single-fenced enclosure (100 square km) in the Mackenzie Bison Sanctuary, if needed. This facility will be used to assist in the capture and testing of wood bison destined for shipment to the Hanging Ice Bison Ranch as breeding stock.

d) Construct abattoir and storage facilities at Fort Smith.

e) Construct winter road from Sweetgrass to Fort Smith (24 km needed) so bison can be trucked to Fort Smith abattoir. Construct access to Slave River Lowlands (Hook Lake and Hanging Ice) so that surplus stock can be brought in to Fort Smith as necessary.

f) Corral and enclosure facilities at Hanging Ice and Hook Lake as well as the abattoir at Fort Smith are to be turned over to the Government of the Northwest Territories when sufficient numbers of disease-free wood bison are released to the wild in Wood Buffalo National Park. These facilities may be used to enhance game ranching opportunities for local people.

g) Compensation for disruption of hunting:

1. Supply 100 bison carcasses per year to be made available to people who lost their hunting opportunities because of depopulation. The supply will come from surplus stock from the Hanging Ice Bison Ranch and/or from purchase of commerical plains bison to meet the local needs.

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COSTS

ITEM		UNIT COST	NUMBER	TOTAL
CORRALS	@	$200,000 ea	5	$ 1,000,000
Large double-fenced enclosures 100 sq km - 10 + 10 + 10 + 10 40 KM	@	20,000/km 800,000	2	1,600,000
Small double-fenced enclosures 10 sq km 5 + 5 + 2 + 2 = 14 km	@	20,000/km 280,000	2	560,000
Single fenced large enclosure 100 sq km 10 + 10 + 10 + 10 40 km	@	10,000/km 400,000	1	400,000
Road construction 24 km to Sweet-grass + same to H.I. & H.L.	est	15,000/km	100 km	1,500,000
Road maintenance, snow plowing	est	200,000/yr	10 yrs	2,000,000
Abattoir, Freezer			1	2,500,000
Portable abattoir			1	500,000
Rendering of Condemned Material				2,250,000
Hay Storage & Corral				50,000
Abattoir Operating Costs including wages	est	275,000/yr	10 yrs	2,750,000
* Bison Transportation by truck by barges				1,000,000 1,000,000
Surveillance	est	190,000/yr	10 yrs	1,900,000
1) Buying Carcasses for Natives	50/yr x 2,000/ccs		10 yrs	1,000,000
(Est. during 10 yr period 1/2 of ccs from depop (1st 3 yrs) & HIBR surplus)				
Removal of enclosures in Wood Buffalo National Park (WBNP)				750,000
Hunting & Carcass Removal, ground and air assistance	est	100,000/yr	10 yrs	1,000,000
		Total	10 yrs	21,760,000

1) Estimates that at least 2/3 of the carcasses will come from slaughter.

* Trucking Bison:

Assume: 20 bison/truck load @ $2.00/km

		From	To		KM	# head	# trips	x 10 yrs	km	Cost
Distances:		EINP	HI		1,575	50/yr	3	30	47,250	94,500
EINP to Ft. Smith	1,500 km	MBS	HI		525	100/yr	5	50	26,250	52,500
MBS to Ft. Smith	450 km	Stgrass	Ft.	Smith	200					
Hook Lake to Ft. Smith	140 km			Yr 1		1500	705			282,000
Hang.Ice to Ft. Smith	75 km			Yr 2		1500	705			282,000
Ft. Smith to Sweetgrass	200 km			Yr 3		1500	705			282,000
EINP to Hanging Ice	1,575 km	HI	Stgs	Yr 4		50	3			550
MBS to HI	525 km			Yr 5		60	3			550
				Yr 6		70	4			600
				Yr 7		80	4			600
				Yr 8		90	5			750
				Yr 9		100	5			750
				Yr 10		100	5			750
										997,550

YEARLY COST BREAKDOWN

Year	Desc. of Costs	Yearly Cost	Total Cost of Project	Total Cost Each Year
1	Start & complete 5 corrals	1,000,000	1,000,000	
1	Start 2 double-fenced enclos. 100 sq km ea	800,000	1,600,000	
1	Start 2 double-fenced enclos. 20 sq km ea	280,000	560,000	
1	Start 2 single-fenced enclos. 100 sq km	200,000	400,000	
1	Start Road Construction to Sweetgrass, H.I. & H.L.	750,000	1,500,000	
1	Road Maintenance/snow ploughing	200,000	2,000,000	
1	Start one Abattoir/Freezer	1,500,000	2,500,000	
1	Start & complete 1 Portable Abattoir	500,000	500,000	
1	Rendering of Condemned Material		2,250,000	
1	Start & Complete 1 corral & hay shed at Abattoir	50,000	50,000	
1	Start bison transport EINP to HI 50 head, 3 trips	9,450	94,500	
1	Start bison transport MRS to HI 100 head, 5 trips	5,250	52,500	
1	Start surveillance	190,000	1,900,000	
1	Start furnish. carcasses to Natives	100,000	1,000,000	
1	Start Special Assistance Fund Hunting & Carcass Removal	100,000	1,000,000	5,684,700
2	Complete 2 double-fenced enclos. 100 sq km ea	800,000		
2	Complete 2 double-fenced enclos. 10 sq km ea	280,000		
2	Complete 1 single-fenced enclos. 100 sq km	200,000		
2	Complete road construction to Sweetgrass, HI & HL	750,000		
2	Road maintenance/snow ploughing	200,000		
2	Complete 1 Abattoir/Freezer	1,000,000		
2	Rendering	750,000		
2	Bison transport EINP to HI	9,540		
2	Bison transp. MBS to HI	5,250		
2	Surveillance	190,000		
2	Furnish Carcasses to Natives	100,000		
2	Special Assist. Fund, Hunting & Carcass Removal	100,000		
2	Start transfer Park Bison 1,500 hd to Ft. Smith	282,000		
2	Start Tranfer Park Bison-barge costs	333,333		
2	Start Abattoir operating costs	550,000	2,750,000	5,550,33

Year	Desc. of Costs	Yearly Cost	Total Cost of Project	Total Cost Each Year
3	Road Maintenance/snow ploughing	200,000		
3	Bison Transport EINP to HI	9,450		
3	Bison Transport MBS to HI	5,250		
3	Surveillance	190,000		
3	Furnish Carcass to Natives	100,000		
3	Hunting/Carcass Removal	100,000		
3	Transfer Park Bison to Ft. Smith 1500 head	282,000	853,000	
3	Transfer Park Bison - barging costs	333,333	1,000,000	
3	Abattoir Operating Costs	275,000		
3	Rendering	750,000		2,245,033
4	Road Maintenance/snow ploughing	200,000		
4	Bison Transport EINP to HI	9,450		
4	Bison Transport MBS to HI	5,250		
4	Surveillance	190,000		
4	Furnish Carcasses to Natives	100,000		
4	Hunting/Carcass Removal	100,000		
4	Complete Transfer Park Bison to Ft. Smith - 1500 head	282,000		
4	Complete Transfer Park Bison barging costs	333,333		
4	Start Bison Transport (pure wood bison) HI to Sweetgrass-50 head	550		
4	Rendering	750,000		2,245,583
5	Road Maintenance/snow ploughing	200,000		
5	Bison Transport EINP - HI	9,450		
5	Bison Transport MBS - HI	5,250		
5	Surveillance	190,000		
5	Furnish Carcasses to Natives	100,000		
5	Hunting/Carcass Removal	100,000		
5	Abattoir operations	275,000		
5	Bison Transport HI to Sweetgrass 60 head	550		880,250
6	Road Maintenance/snow ploughing	200,000		
6	Bison Transport EINP - HI	9,450		
6	Bison Transport MBS - HI	5,250		
6	Surveillance	190,000		
6	Furnish Carcasses to Natives	100,000		
6	Hunting/Carcass Removal	100,000		
6	Abattoir Operation	275,000		
6	Bison Transfer HI to Sweetgrass 70 head	600		880,300
7	Same as Year 6 (80 head)			880,300

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Year	Desc. of Costs	Yearly Cost	Total Cost of Project	Total Cost Each Year
8	Road Maintenance/snow ploughing	200,000		
8	Bison Transport EINP - HI	9,450		
8	Bison Transport MBS - HI	5,250		
8	Surveillance	190,000		
8	Furnish Carcasses to Natives	100,000		
8	Hunting/Carcass Removal	100,000		
8	Abattoir operation	275,000		
8	Bison Transport HI to Sweetgrass 90 head	750		880,450
9	Same as Year 8 (100 head)			880,450
10	Road Maintenance /snow ploughing	200,000		
10	Bison Transport EINP - HI	9,450		
10	Bison Transport MBS - HI	5,250		
10	Surveillance	190,000		
10	Furnish Carcasses to Natives	100,000		
10	Hunting/Carcass Removal	100,000		
10	Abattoir operation	275,000		
10	Bison Transport HI to Sweetgrass	750		
10 or	Removal of park facilities later	750,000	750,000	1,630,450
			TOTAL	$ 21,757,549

7. DISCUSSION

a) Advantages of the Wood Bison Recovery and Disease Eradication Option:

1. Wood Bison Recovery

a. The Mackenzie Bison Sanctuary is home for the world's largest herd of disease-free wood bison which is considered to be a national heritage resource.

b. Establishment of two wood bison breeding herds in the Slave River Lowlands within the original wood bison range, will assist their recovery. The establishment of four separately managed breeding herds of wood bison of over 200 head each will allow the removal of wood bison from the endangered species list.

i. Native people have expressed a concern that hunting rights might be restricted for wood bison. Once the sub-species is off the endangered species list, this will not be a problem. In the Northwest Territories, some regulated hunting is permissible for certain endangered species as exemplified by barren-ground caribou, polar bears and wood bison.

ii. Present regulations in Alberta do not allow trade in wildlife (wood bison are considered wildlife in Alberta) or their products. This problem is under review.

c. Implementation of the disease eradication and replacement option will eliminate any direct danger of disease (tuberculosis and brucellosis) transmission to this national treasure of free-ranging wood bison in northern Canada.

d. This proposal identifies a mechanism for wood bison recovery, if experts in the field of genetics and taxonomy determine that genetic sampling from existing stock in Wood Buffalo National Park is warranted and beneficial (see Appendix I). This can proceed without hampering the rest of the proposal, and without significantly altering the time table, but will require additional cost. In addition to the total cost increase, there will be an associated risk oftransmission of disease to the repopulation stock.

e. Implementation of this proposal will assist the repopulation of Wood Buffalo National Park with disease-free wood bison by:

i) constructing holding facilities for wood bison in the Park areas and in areas adjacent to Wood Buffalo National Park.

ii) establishing a wild disease-free wood bison herd on alternate federal lands and under the protection of the National Parks Act for long term conservation.

iii) using as short a time frame as is feasible between the depopulation phase and the repopulation phase (i.e. 1 year maximum). This will help alleviate concerns regarding potential negative impacts on tourism.

2. Establishment of a viable wood bison ranch in the Slave River Lowlands is desired by Native people.

   a. At the termination of the replacement project for Wood Buffalo National Park, the Hanging Ice Ranch facility and abattoir in Fort Smith could be turned over to the Government of the Northwest Territories who could make these facilities available to interested local communities.

   b. The wood bison ranch concept is an excellent opportunity for the Native people to cooperately participate in the disease eradication and recovery program for wood bison.

   c. The Hanging Ice Bison Ranch is an excellent alternative to the presently declining bison population in the Hook Lake area of the Slave River Lowlands.

3. Establishment of a free-roaming population of disease-free wood bison would strengthen the "World Heritage Site" designation for Wood Buffalo National Park by:

   a. reintroducing a major population of wood bison within historical range.

   b. fostering conservation of a national resource and assisting in the recovery of threatened wildlife. This is a project of international significance.

   c. fulfilling a Canadian obligation to correct past mistakes in the conservation of wood bison.

4. Implementation of the replacement option will increase employment opportunities for Native people in the Northwest Territories and in the Wood Buffalo National Park region.

   a. Initially, construction crews will be needed to build corrals and fences at Sweetgrass, Hay Camp, Hanging Ice Bison Ranch, and Hook Lake, and to construct the abattoir at Fort Smith.

   b. Short-term employment will be created once the abattoir and storage facility is built at Fort Smith, during the construction of the 24 km road to connect Sweetgrass with the road to Fort Smith, and after the road is built.

c. Short-term employment will be created to bait bison into the Sweetgrass and Hay Camp enclosures to handle animals once they are rounded up and to load bison for shipment to the abattoir in Fort Smith.

d. There will be contract employment opportunities for putting up hay for Sweetgrass, Hay Camp, and the Hanging Ice Bison Ranch sites.

e. Longer term employment will be required for surveillance crews during the depopulation phase until the disease- exposed bison population is removed.

f. Site managers will be needed over a longer term at Hanging Ice Bison Ranch, Hook Lake, and Sweetgrass.

g. Seasonal work will be available when the abattoir in Fort Smith is operational.

h. It is estimated that during years one (1) and two (2) seventy (70) seasonal jobs will be available each year for Native people. During years three (3) through eight (8) there will be thirty (30) seasonal jobs available.

5. Implementation of the replacement option will increase business opportunities in the region by:

   a. providing guiding and outfitting opportunities.

   b. enhancing the processing and sale of bison products, such as meat, hides, capes, and other non consumptive parts through commercial outlets.

6. The replacement option will provide the only satisfactory resolution to agricultural interests in the tuberculosis and brucellosis problem by eliminating the present threat to domestic stock.

7. Disease eradication and recovery of wood bison in Wood Buffalo National Park and adjacent areas will allow Alberta to proceed with the reintroduction of wood bison into northern Alberta.

8. Most interest groups agree that returning Wood Buffalo National Park to its original purpose and state would be a significant national conservation effort that would reestablish wood bison in its natural habitat within historic range as the world's largest naturally regulating disease-free herd of wood bison. Implementation of the wood bison recovery and disease eradication option will provide a satisfactory resolution to the major concerns of government agencies, biologists, geneticists and other interest groups by maintaining the heritage resource of wood bison free of disease and genetic contamination.

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b) Disadvantages of the Wood Bison Recovery and Disease Eradication Option:

1. The repopulation proposal is expensive and will require expenditures of large sums of public money.

2. Wood Buffalo National Park will continue to exist but without a large, free-roaming herd of bison duing the depopulation and repopulation years.

3. The procedure for depopulation of the disease-exposed bison may not be readily acceptable by certain public interest groups.

4. The predator-prey relationship will be negatively affected, but this os not considered to be unacceptable because the change is likely to be only temporary.

CONCLUSION

Although the estimated cost (21.7 million) to implement the disease eradication and replacement option is high, the overall benefits are great. This option would provide a solution to the disease problem for the livestock industry and would conserve a threatened subspecies of wildlife that is of national significance as a heritage resource. It would strengthen the World Heritage Site designation for Wood Buffalo National Park. Reestablishment of a major population of disease-free wood bison into original habitat would be completed and into an area of permanent protection under the National Parks Act. Native people can participate in this important process and can benefit economically in the short and long term. Furthermore potential disease problems for the livestock industry will be eliminated which, in the long term, will save considerable monies, by reducing the cost of disease monitoring programs. Perpetuation of a national disease-free status will benefit the industry economically.

APPENDIX I

GENETIC SALVAGE - SUB-OPTION

Genetic salvage of disease-exposed wood bison stock in and adjacent to Wood Buffalo National Park is proposed in the Task Force Report. The necessity of considering this facet of the disease elimination option is contingent upon the determination that valid wood bison genetic material remains in this region. If this sub-option is to be considered in the general depopulation/repopulation scheme, it can readily be done so.

1. Dr. van Zyll de Jong was asked to provide comments regarding preservation of the maximum genetic diversity in wood bison. Refer to attachment - Appendix IV.

2. A phenotypic evaluation of bison populations can be done during Year 0 to determine if genetic salvage is warranted. Ideally phenotypic assessment of stock at the following four locations should be done: Nyarling River, Hay Camp, Sweetgrass and Hook Lake. At minimum, the extremes should be samples, i.e. Hook Lake in the north and Sweetgrass in the south. if warranged, based on the phenotypic assessments, further genetic evaluation of a particular population can be done.

3. Genetic testing as a follow up confirmation to pheotypic assessment can start as soon as stock is captured. We would expect this procedure to run parallel with the depopulation phase.

   a) Bison can be caught, tested, and held until all genetic evaluation is completed, DNA fingerprinting, blood typing.

   b) Any bison positive to brucella and/or tubercu[illegible]is testing will be disposed of immediately. The remaining stock will be retested (brucellosis and tuberculosis) at frequent intervals as required by Agriculture Canada.

   c) "Disease-free" genetically valuable stock may be moved to the Hook Lake facility and held for further disease testing procedures.

   d) Once all stock is removed from the capture corral and enclosure, the area is depopulated and the facility remains empty for one year, restocking with disease-free wood bison into this compound may begin.

4. Any salvaged bison to be transferred to the Hook Lake facility must be subject to the following procedure:

   a) All bison must be negative to brucella and tuberculosis tests before transfer to corral and must be positively identified with eartags.

b) Bison will be maintained within doubled-fenced enclosures and allowed to breed.

c) First generation offspring will be separated at birth and hand raised. Each animal will be identified with eartags, anthrax vaccinated, and brucella and tuberculosis tested at appropriate times as determined by Agriculture Canada. These animals will be kept in a separate doubled-fenced enclosure and allowed to breed. The original stock will be eliminated.

d) The second generation offspring will also be separated at birth and hand raised in a third doubled-fenced enclosure, identified, anthax vaccinated, brucella and tuberculosis tested as per (c). First generation stock will be eliminated.

e) All second generation animals will be tested after the calving. Any reactors will be removed and slaughtered immediately after testing.

f) If second generation stock remain tuberculosis and brucella free after their first calving season, they and their offspring may be used for breeding stock.

g) All stock are to be anthrax vaccinated yearly if possible.

5. A number of facts must be considered regarding the genetic salvage sub-option. The present rate of infection is 36% for each disease. Not every animal harboring tuberculosis harbors brucellosis, however, it is conceivable that approximately 50% of the genetic salvage bison could be eliminated based on tuberculosis and brucellosis testing. It will be necessary to eliminate bison that are in poor condition regardless of their test results. The tuberculosis test can give false negative readings especially in debilitated animals, where the immune system is overwhelmed by the infection. Also, with brucellosis, there are recorded cases in which an infected dam has passed this disease to her calf, and the calf tested negative for many years (nine is the longest on record) before showing infection. Therefore, there are great risks involved with the salvage operation involving disease-exposed animals. The normal procedure in the cattle industry is herd depopulation. Agriculture Canada's Captive Wild Ungulate policy now also calls for depopulation, therefore, if any animal at any stage of this operation reacts to either brucellosis or tuberculosis, the entire salvage operation is lost.

Funds for genetic salvage have not been identified in the proposed budget. It is believed that for the possible number of salvageable bison, the cost far outweighs the disease risk.

APPENDIX II

PROBLEMS WITH SLAUGHTERING AND MEAT PRODUCTION PROPOSALS:

1. Under optimum conditions, federal inspection will be required if meat for human consumption is to be produced for inter-provincial and/or international movement.

   a) Under the present Meat Inspection Act and Regulations, portable slaughter facilities are not permitted for processing bison.

   b) Alberta Wildlife Act and Regulations prevent the sale of meat from wildlife. These will have to be reviewed in the context of this proposal.

   c) Is it possible that the Meat Hygiene Act and Regulations could be changed to accommodate the movement of provincially inspected meat between the provinces?

2. Disposal of inedible, condemned material and wastes from slaughter of disease-exposed bison will present problems.

   a) Disposal will be a problem when using either a portable or permanent slaughtering facility.

   b) Rendering will be the most desirable method, however burying may be considered.

   c) Potential for salvage of inedible products for dog or mink food, or transportation of condemned carcasses and material for rendering to the south in leak-proof trucks is a feasible option.

3. Storage of edible products.

   a) Regardless of the season, when slaughter is conducted, a large, efficient freezing plant must be available.

APPENDIX III

Hanging Ice Proposal - Hook Lake Proposal

1. It is proposed that negotiations begin as soon as possible with the Fort Smith Hunters and Trappers Association, and offer assistance for the Hanging Ice Bison Ranch Project to establish a breeding herd of wood bison.

   a) The Ranch would be a key to building up a disease-free wood bison herd, the initial offspring of which could be transferred to Wood Buffalo National Park as part of the disease eradication and herd replacement option.

   b) Assistance in the form of financing the building of the corrals and double-fenced enclosures of 10 square km may be offered. The disease risk is such that the added expense for double fenced corrals is necessary. Under Agriculture Canada's Captive Wild Ungulate Policy, any discovery of either tuberculosis or brucellosis in the breeding herd would result in immediate and complete slaughter of the entire herd.

   c) Other assistance would be the building of an abbatoir/cooler/freezer facilities for bison in Fort Smith that could be turned over to the Government of the Northwest Territorties as soon as the replacement project is completed.

2. With the repopulation option, there will be a time during which there will be no free-roaming bison to hunt in the Slave River Lowlands as well as other areas adjacent to Wood Buffalo National Park in the Northwest Territories and Alberta.

   a) This time gap should be as short as possible.

   b) At present hunting rates, it is likely that the Slave River Lowlands bison population of around 200, with its low reproduction rate, will not be available for hunting within five years.

   c) The herd replacement option is intended to get Wood Buffalo National Park repopulated as quickly as posible so that wild bison will again roam out of the Park and be available for hunting by the local people.

      1. Nationally, COSEWIC requires four independently managed populations of at least 200 animals each in order that the wood bison be removed from the endangered species list.

   d) During the repopulation phase, the following points should be part of the proposal to the Hunters and Trappers Association.

1. In a recent study of Native diets (Wein & Sabry, 1989), bison constituted 25% of the big game meats eaten.

2. At the present rate of use, 50 - 60 bison carcasses per year need to be made available to local communities.

3. There will be surplus animals from the Hanging Ice and Hook Lake Bison Ranch. These should be available for local community use.

4. What cannot be furnished from surplus stock will have to be made up from commercial purchases of plains bison.

5. Meat compensation must continue until enough free-roaming wood bison are available outside the Park or until the population in the Park is equal to or greater than that when the depopulation was instituted.

6. During depopulation of bison in Wood Buffalo National Park, some inspected and passed carcasses should be made available for local consumption.

3. A similar setup to Hanging Ice Bison Ranch is proposed for Hook Lake to establish another breeding herd of wood bison and to accommodate the genetic salvage option should that be required.

4. There should be two separate breeding herds of wood bison established whose offspring for a number of years will be required for restocking of Wood Buffalo National Park. An ageement is needed to specify the number of animals and the time frame required to repopulate Wood Buffalo National Park.

5. When Wood Buffalo National Park is repopulated under the disease eradication and her replacement option, both bison ranches and their breeding stock are to be turned over to the Government of the Northwest Territories to provide opportunities for development of commercial wood bison ranches for Native people.

6. If genetic recovery from Park stock is necessary, bison that are tested and are negative to tuberculosis and brucellosis, can be brought to the Hook Lake corral and enclosure. They will be maintained there, retested, and allowed to breed (refer to Appendix I).

   Should this happen, all Elk Island National Park and Mackenzie Bison Sanctuary seed stock would be transferred to the Hanging Ice facility until Hook Lake herd is cleared of disease potential. Salvaged stock from Wood Buffalo National Park must not be mixed with the disease-free Elk Island National Park or Mackenzie Bison Sanctuary stock for at least ten (10) years. A management committee should be set up to determine at what point the above stock can be introduced. This committee should include representatives from the Hunters and Trappers Association, the Government of the Northwest Territories, the Canadian Wildlife Service, Canadian Parks Service and Agriculture Canada.

Environment Canada / Environnement Canada
Parks / Parcs

457 Main Street
Winnipeg, Manitoba
R3B 3E8

13 October 1989

TO Edwards EE
ENVIRONMENT CANADA
OCT 13 1989
FILE No. 4911-32 IR3
Your file / Votre référence
9810-103/V3
40

Mr. C. Lachance
Executive Secretary
Northern Diseased Bison
Environmental Assessment Panel
510-750 Cambie Street
Vancouver, B.C.
V6B 2P2

Dear Mr. Lachance:

Re: Environment Canada Response to Diseased Bison Information Requirements

Enclosed is a copy of the Department of Environment response to the information requirements requested by the Northern Diseased Bison Environmental Assessment Panel.

This response includes replies to Panel questions from both the Canadian Parks Service and the Canadian Wildlife Service. In most cases, a single Departmental response is provided. However, in other cases, given differences in mandates and responsibilities, the responses are specific to one agency.

Our apologies to the Panel for the additional time required to prepare this Departmental response. Should supplementary information be required, we look forward to hearing from the Panel.

Yours sincerely,

W. Douglas Harper
Director General
Canadian Parks Service
Prairie and Northern Region

for B. Burns
Director General
Conservation and Protection
Western and Northern Region

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INFORMATION REQUIREMENTS
FOR THE
NORTHERN DISEASED BISON
ENVIRONMENTAL ASSESSMENT PANEL

ENVIRONMENT CANADA RESPONSE

W. Douglas Harper
Director General
Canadian Parks Service
Prairie and Northern Region
457 Main Street
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B. Burns
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13 October 1989

DEPARTMENT OF THE ENVIRONMENT
RESPONSE TO INFORMATION REQUIREMENTS
FOR THE
NORTHERN DISEASED BISON ENVIRONMENTAL ASSESSMENT PANEL

INTRODUCTION

In February 1989, the federal Minister of the Environment appointed a five-member Northern Diseased Bison Environmental Assessment Panel to conduct a public review of the issues associated with diseased bison inhabiting lands in and around Wood Buffalo National Park and to make recommendations. The Panel issued information requirements in July 1989 in the form of questions to be responded to by government agencies and Panel-hired experts.

Replies by the Canadian Parks Service and the Canadian Wildlife Service are consolidated into this Department of the Environment (DOE) response. Where possible joint responses are made, but because of differing mandates, individual agency responses are sometimes appropriate.

Background material on Departmental mandates for national parks and wildlife is provided for reference purposes. Responses are based upon the National Parks Act and Regulations, Canadian Parks Service Policy, Wood Buffalo National Park Management Plan, Canada Wildlife Act, Canadian Wildlife Service Endangered Species Policy, and the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), Recovery of Nationally Endangered Wildlife (RENEW), World Conservation Strategy, Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), as well as related Departmental files, reports, and documents.

BACKGROUND

Canadian Parks Service

Under the National Parks Act (Canada 1988) national parks are dedicated to the people of Canada for their benefit, education and enjoyment, and are to be maintained and made use of so as to leave them unimpaired for the enjoyment of future generations. The National Parks Act provides for the preparation of a Park Management Plan for each national park addressing resource protection, zoning, visitor use and other matters. Maintenance of ecological integrity through the protection of natural resources is given first priority in Park Management Plans.

Canadian Parks Service Policy

The Canadian Parks Service objective for national parks is to protect representative natural areas of Canadian significance and to encourage

public understanding, appreciation and enjoyment so as to leave them unimpaired for future generations. Natural resources within national parks are protected and managed with minimal interference to natural processes to ensure the perpetuation of naturally evolving land and water environments and their associated species (Canada 1979).

Manipulation of naturally occurring processes such as fire, insects and disease may take place only after monitoring has shown that:

i) there may be serious adverse effects on neighbouring lands;
ii) public health or safety is threatened;
iii) major park facilities are threatened;
iv) natural processes have been altered by man and manipulation is required to restore the natural balance;
v) a major natural control is absent from the park;
vi) the continued existence of a plant or animal species, which is rare or endangered or which is critical to representation of the natural region, is threatened by a natural cause such as insects or disease; or
vii) the population of an animal species or stage of plant succession which has been prescribed in the objectives for a park, cannot be maintained by natural forces.

Where active resource management is necessary, techniques are to duplicate natural processes as closely as possible. Such management actions must take in to account factors such as park size, objectives, zoning, geographic location and the nature of activities occurring in surrounding areas.

A species of plant or animal which has been native to, but is no longer present in the park area, may be re-introduced if:

i) the effect on other plants and animals is acceptable;
ii) such action is compatible with park objectives; and
iii) no serious problems are posed for neighbouring lands.

In addition, non-native species of plants and animals will not be introduced into a national park and, where they exist, efforts will be made to remove them.

Wood Buffalo National Park Management Plan

A Park Management Plan is a guide, approved by the Minister, by which the Canadian Parks Service administers the resources and uses of a national park. It translates Policy statements into actions which are implemented under the direction of the Park Superintendent. A Plan provides information on the opportunities for public understanding and enjoyment, indicates the degree of resource protection and serves as a document that specifies hov particular issues are to be resolved.

The Wood Buffalo National Park Management Plan (Canada 1984) defines hov the park is to protect an outstanding and representative example of the Northern Boreal Plains natural region and portions of the Southern

Boreal Plains and Northwestern Uplands regions, and to enable present and future generations to appreciate and experience the parks's wilderness environments. It is the responsibility of the Canadian Parks Service to ensure that the park remains an integral example of the Northern Boreal Plains ecosystem by alloving natural forces and processes, that created the park, to play their part in the maintenance and natural evolution of the park. Wildlife resources are to be managed through non-interference to the extent possible. Parks vill manage and protect significant, endangered or sensitive species such as bison to ensure their continued survival and, when required, increase their numbers and well-being.

Preservation of wood bison (Bison bison athabascae) vas the initial reason for establishment of Wood Buffalo National Park in 1922. Bison figure prominently in its history, remain as one of its prime resources and contribute to its status as an area of international significance. The primary objective for the management of bison is to allov park bison to be regulated by natural means without human influences. Manipulation of naturally occurring processes affecting bison will only be undertaken if monitoring indicates that the population is declining to a dangerously lov level, which would endanger the long-term survival of the herd.

The Park Management Plan provisions specific to bison are as follovs:

1) Bison will remain a fully protected species and no harvesting will take place. The ecology and management of bison will serve as a major theme and resource on which to focus the park interpretive program. Information and interpretation programs will continue to be used to inform the public of research and management programs.

2) Monitoring of bison in terms of abundance, social organization, reproduction and mortality, range relationships and distribution and movements will continue. Efforts will be directed tovard the consistent and regular collection of observations, and the orderly compilation of such information.

3) Research on the role of disease in the dynamics of the herd is a priority issue. Such research will be conducted using methods and techniques that will not apply stress to the animals as appropriate in any of Canada's national parks. Disease research programs will be reviewed and approved by the Canadian Parks Service, Canadian Wildlife Service, and Agriculture Canada prior to implementation.

4) To safeguard against threats to public safety and health due to the presence of disease in the herd, existing arrangements with Agriculture Canada regarding the Animal Disease and Protection Act and Regulations will be maintained. Discussions will also be held between the Canadian Parks Service, the governments of the Northvest Territories and Alberta, and Agriculture Canada concerning the designation of a buffer zone adjacent to the park boundary in which domestic livestock operations will not be

permitted. Bison outside the park boundary may be shot by native people or general hunting licence holders, thus assisting with control of diseased bison moving into lands adjacent to the park.

World Heritage Convention

The Canadian Parks Service is the lead agency in Canada for the World Heritage Convention. The objective of the Convention is "to ensure as far as possible, the proper identification, protection, conservation and presentation of the world's irreplaceable heritage...". Canada's responsibilities include the identification and protection of designated heritage resources. Signatories to the Convention are also to refrain from any deliberate measures which might damage the cultural and natural heritage and to take necessary legal, scientific, technical, administrative and financial measures for heritage site protection. The Convention also allows for the deletion of sites from the World Heritage List if the qualities for which they were nominated are lost.

Canadian Wildlife Service

Canada Wildlife Act

The mandate of the Canadian Wildlife Service with respect to conservation of wood bison and other wildlife is defined in the Canada Wildlife Act (Canada 1973) and the Government Organization Act (1970) - Part 1, Department of the Environment Act (Canada 1970).

The Canada Wildlife Act enables the Minister of the Environment to:

a) undertake, promote or recommend measures for the encouragement of public cooperation in wildlife conservation and interpretation;
b) initiate conferences and meetings respecting wildlife research, conservation and interpretation;
c) undertake programs for wildlife research and investigation and establish and maintain laboratories and other necessary facilities for that purpose; and
d) coordinate and implement wildlife policies and programs in cooperation with the government of the province having an interest therein.

Under Section 5 of the Canada Wildlife Act, the Minister of the Environment may, with the approval of the Governor in Council, enter into an agreement with the government of any province to provide for the undertaking of wildlife research, conservation and interpretation programs and measures, the administration of lands for such purpose or the construction, maintenance and operation of facilities and works related thereto. Under Section 9 of the Act, the Minister may, in cooperation with one or more provincial governments having an interest therein, take such measures as he deems necessary for the protection of any species of non-domestic animal in danger of extinction.

The Department of the Environment Act (Section 5) states that the duties, powers, and functions of the Minister of the Environment extend to and include the preservation and enhancement of the quality of the natural environment, including water, air and soil quality, and renewable resources, including the forest resources of Canada, migratory birds, and other non-domestic flora and fauna.

Recovery of Nationally Endangered Wildlife in Canada

The RENEW organization is a committee composed of the directors of provincial, territorial, and federal wildlife agencies plus the heads of three major national conservation organizations (Canadian Nature Federation, Canadian Wildlife Federation and World Wildlife Fund Canada). RENEW's strategy is to create a recovery team for each species listed by COSEWIC and to prepare a management plan to recover the species based on the best knowledge and methods available. Terms of reference and membership of the Wood Bison Recovery Team have been approved by RENEW.

World Conservation Strategy

The Government of Canada supports the aims and objectives of the World Conservation Strategy (Pollard and McKechnie 1986), including the goals of: a) maintenance of essential ecological processes and life support systems, b) preservation of genetic diversity, and c) sustainable utilization of species and ecosystems. The Department of the Environment actively supports item c) within the Sustainable Development Program.

Wood Bison Recovery Program

The Canadian Wildlife Service initiated and is coordinating the Wood Bison Recovery Program in cooperation with Canadian Parks Service (Elk Island National Park), Northwest Territories Renewable Resources, Yukon Renewable Resources, Alberta Forestry, Lands and Wildlife, Manitoba Natural Resources, Indian Bands, and non-government organizations, to re-establish wild herds of wood bison in areas of historic range. Agreements under the Canada Wildlife Act with the governments of Alberta, Manitoba and Yukon Territory have been instrumental in establishing wood bison recovery projects in these areas. The Canadian Wildlife Service also shares a management responsibility for all captive wood bison and, in particular, exercises a management control in cooperation with Alberta Fish and Wildlife Division and the Dene Tha Indian Band for a captive herd of wood bison near Hay-Zama Lakes in northern Alberta.

Current research has confirmed the validity of subspecific status for present day wood bison based on its close taxonomic proximity to the original (pre-1925) wood bison (van Zyll de Jong 1986). The Wood Bison Recovery Team, under the mandate of RENEW, is developing a Wood Bison Recovery Plan. The ultimate goal of the recovery plan and program is to restore wood bison as a major faunal element to former wild ranges in northwestern Canada (Reynolds 1987, 1988). The threat of disease and genetic contamination to re-introduced wood bison is limiting

opportunities for recovery.

In 1979, the wood bison was classified by COSEWIC as an endangered subspecies of the North American bison (Novakovski 1979, Cook and Muir 1984). In 1988, COSEWIC changed the status to threatened after acceptance of the revised wood bison status report prepared by the Wood Bison Recovery Team (1987). The criterion accepted by COSEWIC for delisting wood bison is four geographically separate populations of at least 200 animals each. At present, the Mackenzie Bison Sanctuary and the Elk Island National Park herds are the only two populations exceeding 200. The recently introduced populations in the Nahanni area of the NWT and in the Yukon are small relative to target size, and their future growth is unpredictable. In addition, the wood bison is listed in Appendix I of CITES, thus prohibiting international trade of this subspecies (CITES Control List No. 8, 24 July 1989).

PANEL QUESTIONS/DOE REPLIES

3.0 CURRENT STATUS

3.1 Panel Question: If the current status is maintained (i.e. the existing free-roaming herd remains in the area), what specific measures will your agency implement to reduce or eliminate risk to people, cattle, domestic bison, and other wildlife from:

i) disease transmission;

DOE Reply

If the current status is maintained, the Canadian Parks Service is prepared to implement the following measures:

1. Development and implementation of a public education program. The program would inform local people and park users about diseases in bison and management measures being taken by the Canadian Parks Service and other agencies to reduce or eliminate risks to people, cattle, domestic bison and other wildlife. The role of Wood Buffalo National Park in protecting bison would be included under that program. Procedural guidelines would be put into place for the handling and disposal of bison (similar to present Anthrax procedures) to minimize any risk of disease transmission to people. Part of the program would be a park brochure on bison diseases.

2. Development and implementation of a co-operative research/monitoring program. The program would consist of two parts: a research component on bison population dynamics and habitat requirements; and a monitoring component to track the distribution of bison in the park for transboundary movements. Research is required to further understand bison distribution and movements which have changed over the past decade. A structured monitoring program would be designed. It would concentrate on known areas of transboundary movements. Where prudent and subject to results of research, boundary clearings would be widened to facilitate the detection of bison and their tracks. The appropriate

government agencies would be notified when bison are determined to be approaching or crossing park boundaries. The effectiveness of enhanced monitoring will be directly related to levels of funding and effort expended. For example, daily monitoring may be required for parts of the park at certain times of the year. The use of telemetry to track and locate migrating bison will increase the effectiveness of monitoring.

3. Support to the establishment of bison-free buffer zones exterior to the park. Buffer zones will offer no guarantee although they will be more effective than no buffer zone. The success of buffer zones could be high if: all jurisdictions (Canada, Alberta, and Northwest Territories) cooperated to increase effectiveness; a no-limit, open hunting season existed for bison in the zones; and designated authorities were notified of any bison observations made in the zones. Since cattle in the region have not contracted the diseases from wild bison under present circumstances, buffer zones may provide additional control and assurance to concerned agencies. Land use plans would be needed to keep livestock away from the park boundary. A bison-free zone would be ineffective if ranching operations were permitted to operate adjacent to park boundaries.

In addition, the Canadian Parks Service would be prepared to consider construction of limited barrier fencing to further enhance a bison-free zone. Such fencing might strategically be placed in various locations both inside and outside the park. However, fences could be periodically breached by falling trees, fires, snow drifts and other factors. Monitoring and surveillance would assess effectiveness and may lead to required modifications. Further studies of current bison movements and terrain features would be required as well as agreement by land claim wildlife management boards.

If the status quo is maintained, specific measures that the Canadian Wildlife Service will implement to reduce or eliminate risk of disease transmission to wood bison are as follows:

Wood Bison - Although the Canadian Wildlife Service does not have direct management responsibility for free-roaming herds of wood bison, the Canadian Wildlife Service encourages and will assist other agencies to implement measures, where necessary, to prevent disease contamination of wood bison, especially for the Mackenzie Bison Sanctuary population. Continuation of this interim measure will be required until a long-term solution to the problem is found.

The Canadian Wildlife Service will recommend cancellation of the co-operative re-introduction project at Hay-Zama Lakes in northwestern Alberta because the risk of disease contamination would be judged to be unacceptable for a wild free-roaming herd. There would be no further effort to re-introduce wood bison into the historic range in Alberta.

People - It is known that people can contract bovine brucellosis (undulant fever) and bovine tuberculosis from animals, therefore, there is a risk to humans. In 1985, a survey in the park region found brucellosis and/or tuberculosis in 24 of 56 (43%) bison killed by

hunters (Tessaro 1987). The prevalence of disease in bison in the region is well known. Regarding disease risk to park staff, local people, and park visitors, human health problems from bison infected with brucellosis and tuberculosis have not been reported to the Department of the Environment. On the other hand, these diseases may be misdiagnosed or under-reported by as much as 25 times based on recent information from the United States (Estipona et al. 1989). Although the Department has no legislative responsibility to eliminate the risk of disease transmission to people, the Department will cooperate with responsible medical agencies to research, assess, and prevent infection of humans.

ii) genetic contamination of wood bison?

DOE Reply

The buffer zone concept identified in 3.1 (i) to reduce the risk of disease transmission is also applicable to the genetic contamination issue.

3.2 Panel Question: Assess the effectiveness of each measure identified in section 3.1, and rate the probability of success.

DOE Reply

The Canadian Parks Service response is included in section 3.1.

The Canadian Wildlife Service believes that the buffer zone measure identified in section 3.1 is not a completely effective means of controlling bison movements. For example, in Yellowstone National Park, Meagher (1989) reported that a number of techniques which had been tried since 1976 to contain bison within park boundaries, were ineffective. Furthermore, these efforts were observed to cause major shifts in bison movements to other travel routes or sometimes displaced a conflict from one site to another. Techniques employed in Yellowstone were: 1) hazing and herding activities, 2) blocking main travel routes, 3) harassment of animals with various mechanical devices, and 4) cropping of bison by public hunting for those wandering outside park boundaries. It is probable that bison will find a way to cross boundaries even where their passage is physically blocked. It would be nearly impossible (logistically and financially) to constantly patrol a buffer zone and to monitor bison that can move at any time of day or night, particularly during the snow-free season, without being detected.

Cancellation of the Hay-Zama wood bison re-introduction project would restrict the Wood Bison Recovery Program. The potential range for recovery of wood bison in northern Alberta, exclusive of Wood Buffalo National Park, approximates 239,000 km² or about 39% of the historic range of wood bison. In addition to establishing another herd of wood bison for delisting purposes, the Hay-Zama project would serve as a nucleus population for restocking a large part of former range in northern Alberta as well as providing a new major economic resource for local communities.

3.3 Panel Question: What are the estimated ongoing costs (to government, industry, and the public) associated with each of the protection measures identified in section 3.1?

DOE Reply

The Canadian Wildlife Service believes that cancellation of the Hay-Zama wood bison re-introduction project will result in direct loss to the governments of Alberta and Canada and to the Dene Tha Indian Band of approximately $300,000 thus far invested, plus an additional $200,000 estimated for salaries and administration. Also, removal of the herd is estimated to cost governments (Alberta, Canada) and the Dene Tha Band approximately $20,000 plus an additional $50,000 estimated for facility removal if no alternative use can be found.

See Bison Disease Task Force report and Annex I for additional cost information.

3.4 Panel Question: What are the estimated costs if the proposed protection measures fail? Include social and economic costs appropriate to the mandate of your agency, associated with:

3.4.1. Disease transmission to:

people - cost to infected people
- cost to government health care system

domestic cattle and bison
- cost to farmer
- cost to consumer
- cost to industry
- cost to government

wild bison and other wildlife
- cost to hunter
- cost to consumer
- cost to government

DOE Reply

If the buffer zone (identified in section 3.1) should fail and the Mackenzie Bison Sanctuary and Nahanni populations of wood bison become contaminated with bovine diseases, direct costs to control and/or eradicate these diseases are unknown.

Disease contamination of the Mackenzie Bison Sanctuary and Nahanni populations (approximately 80% of the world's wood bison) would seriously threaten the Wood Bison Recovery Program. It would result in a significant impoverishment of the resource and consequent loss to conservation for which monetary values cannot be determined. In addition, disease infection would prevent the use of diseased stock for future re-introduction projects and for exchange programs to maximize genetic diversity within the wood bison gene pool unless a costly disease elimination and herd reduction program were undertaken. In the

opinion of the Canadian Wildlife Service, it is unlikely that disease infection would occur without genetic contamination.

The Wood Bison Recovery Program would be prolonged and the Canadian Wildlife Service would continue to address wood bison under CITES. The requirement for export and import permits will remain and international transfers will be restricted. The Canadian Wildlife Service will have to address the issue of captive herd management and continue to pay for maintenance or dispose of captive stock. Budgets to manage the recovery program will have to be maintained.

3.4.2 Genetic contamination of wood bison
- **cost to industry**
- **cost to government**

DOE Reply

a) Cost to Industry

The direct cost to industry as a result of genetic contamination of wood bison is unknown. The loss of potential opportunities for commercial ranching of wood bison would depend on the degree of contamination and the availability of non-contaminated captive stock. Development of a commercial industry for wood bison could be negatively affected if major wild stocks (Mackenzie Bison Sanctuary and Nahanni herds) became genetically contaminated. This would reduce the opportunity for sustainable economic development of the wood bison resource in the region, such as game ranching, selling bison by-products and tourism (ie. viewing, photography, etc.).

b) Cost to Government

Loss of the wood bison subspecies in the wild through disease and/or genetic contamination would be an international concern. Failure to meet the three main objectives of the World Conservation Strategy would represent an important biological and social loss. Such a loss would reflect poorly on Canada's international reputation and responsibility to maintain genetic diversity. Currently, Canada is the sole proprietor of wood bison, a distinct Canadian subspecies, which must be maintained as a separate gene pool to contribute to conservation of genetic diversity on a world scale. Dilution of the wood bison gene pool would not be in alignment with the objectives of the World Conservation Strategy, a strategy that is endorsed by the Government of Canada.

If genetic contamination occurs in wild herds of wood bison, continuation of the recovery program to reestablish free-roaming populations would be pointless. The loss to government would be several million dollars already invested in the program. Should that happen, wood bison would have to be maintained in captive herds at relatively high costs in a manner similar to that which has been used for plains bison (Bison bison bison).

3.5 Panel Question: Identify any negative impacts that presence of the

diseases may have on the development of tourism, agriculture (cattle ranching), game ranching, and any other local industries.

DOE Reply

There is no evidence to suggest that past visitation to Wood Buffalo National Park has been affected by the presence of diseases in bison. Current information indicates that visitors are attracted to the park by the opportunity to view bison in the wild. Should numbers of bison decrease significantly because of disease or manipulations, visitation and related economic benefits of tourism could be impacted. The costs of negative impacts are not known.

The presence of diseased bison will likely restrict further livestock expansion towards the park due to the risk of disease transmission and place limitations on future opportunities because of increased costs.

The Canadian Wildlife Service is reluctant to provide disease-free wood bison to establish either captive or free-roaming herds in areas where bovine diseases are present because of the disease risk. Therefore, future opportunities for game ranching wood bison (e.g. in the Slave River Lowlands) may be restricted until the risk of infection with bovine diseases is reduced or eliminated.

In the view of the Canadian Wildlife Service, the presence of diseases is one factor having a negative impact on sustainable development of other local industries such as, opportunities for native people to hunt bison, to operate guiding outfits for tourists and hunters, and to benefit from commercial sales of bison by-products. Hunting opportunities immediately outside of the park for local native residents have decreased during the last decade and will continue to decrease if bison populations in the area continue to decline.

4.0 MANAGEMENT ACTIONS

4.1 Interim Protection Measures

4.1.1 Panel Question: What interim risk reduction measures will your agency adopt during the implementation of a disease elimination program to protect people, domestic cattle, bison and other wildlife from disease transmission and to prevent genetic contamination of wood bison? For the measures identified, specify locations where and times when such interim protection measures may be required.

DOE Reply

In general, interim protection measures for risk reduction would be the same as those measures specified in the response to section 3.1.

More specifically, the Canadian Wildlife Service will encourage the agencies responsible for the management of wildlife in and around Wood Buffalo National Park (Northwest Territories Renewable Resources, Alberta Fish and Wildlife Division and Wood Buffalo National Park) to establish and maintain buffer zones to reduce the risk of disease

transmission and to prevent genetic contamination of wood bison as follows:

i) maintain the buffer zone for the Mackenzie Bison Sanctuary and expand it for the Nahanni wood bison population; and

ii) continue with the postponement of the release of wood bison from the Hay-Zama corral until such time as the risk has been reduced or eliminated.

4.1.2 Panel Question: Assess the effectiveness of each interim measure, and rate the probability of success.

DOE Reply

The effectiveness of a buffer zone to provide protection for the resources at risk has already been assessed in sections 3.1 and 3.2 and was determined as not being 100% effective. Therefore, a degree of risk will always be present with any buffer zone which must be patrolled frequently. This would be impossible during periods of inclement weather and extended snowstorms when animals could cross a buffer zone without detection. The buffer zone is almost certain to be crossed at some time.

The captive herd of wood bison at Hay-Zama will remain at risk for disease infection. However, removal of the animals through cancellation of the project will obviate the problems of risk associated with maintenance of animals on the site.

4.1.3. Panel Question: What are the estimated costs associated with each of the interim protection measures identified?

DOE Reply

This response is primarily covered in the reply in section 3.1. Costs for buffer zones would vary depending on the intensity of surveillance. The degree of risk would be reduced as the intensity of surveillance increases, but it would never be eliminated. Refer to Annex I for cost estimates.

4.2 Disease Containment

4.2.1. Panel Question: Would your agency's management actions identified in section 3.1 be altered by containment (by fence or buffer zone) of the diseased hybrid herd? Include the effects of containment on the level of risk and costs of management actions.

DOE Reply

No. Management actions identified in section 3.1 include consideration of disease and genetic containment by bison-free buffer zones and limited fencing.

4.3 Disease Elimination

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4.3.1 Feasibility and Cost Considerations

4.3.1.1 Panel Question: What is the feasibility of isolating and maintaining a captive disease-free hybrid herd? Identify alternative means of carrying this out. What are the costs associated with each option? Who would be responsible and involved? What criteria would be applied to certify that a herd is disease-free (considering potential for disease latency)? For what purpose(s) might individuals be salvaged (include potential for use in WBNP, Slave River Lowlands, commercial herds or other parks)? Would salvaged bison be acceptable (for domestic and/or wild breeding stock) by Alberta and Northvest Territories authorities? How would preservation of hybrid bison affect the Wood Bison Recovery Program?

DOE Reply

It is technically possible to isolate and maintain a captive disease-free hybrid herd. To do so effectively would involve the capture, testing and isolation of bison in groups ranging from perhaps 20 to 30 animals and maintaining them in pens until they are certified disease-free according to procedures and guidelines recommended by Agriculture Canada. Several small captive herds would be required, rather than one large herd, to avoid risks of a security breakdown and to enhance maintenance of genetic diversity. Alternatively, new-born animals could be captured, tested and reared as disease-free animals. Costs to isolate and maintain captive disease-free bison are expected to be considerable requiring separate holding facilities for captured animals including corrals, testing facilities, and isolation pens. Costs would depend upon size of the holding areas and the required time to isolate and maintain animals in smaller areas. There would also be feeding costs. Holding time is understood to be at least seven years before disease-free certification, or possibly up to a decade. Total costs may limit the feasibility of this approach.

Holding facilities would be expensive and maintenance activities would also be labour-intensive. A similar means of carrying out such an operation could involve the capture and corralling of a large segment of the population, culling all but pregnant females, salvaging calves shortly after birth, and hand-rearing calves in individual isolated pens where their health would be monitored.

From an operational perspective such proposals are possible but costly. However, regarding feasibility in this park, where there is range capable of supporting large free-ranging bison populations, wilderness quality would be lost by maintaining a captive herd. Feasibility of the approach may also be limited by the number of animals that could be maintained.

In terms of criteria that would be applied to certify that a herd is disease-free, the Parks Service would be guided by Agriculture Canada's established testing and certification procedures. The potential for disease latency is a concern and is recommended as a subject for longer term veterinary research.

If hybrid bison are maintained as a confined herd within the park, they would be considered to constitute a potential threat to any reintroduced wood bison in the park and to wood bison on neighbouring ranges, and would serve no biological purpose.

Maintenance of a captive disease-free hybrid bison herd is not consistent with the mandate of the Canadian Wildlife Service, the objectives of the Wood Bison Recovery Program, or the World Conservation Strategy. Maintenance of a captive hybrid herd in the Park would continue to perpetuate the potential risk for genetic contamination of adjacent herds of wood bison (i.e. Mackenzie Bison Sanctuary, Nahanni, and Hay-Zama).

See Bison Disease Task Force report and Annex I for cost considerations.

4.3.1.2 Panel Question: Is it possible to identify and salvage wood bison from WBNP, the Slave River Lowlands, and areas adjacent to the Park? How would this be carried out? Identify alternative means of carrying this out. What costs are associated with each of the above plans? Who would be involved? Is it possible to eliminate disease from these herds? How would this be carried out? What criteria would be used to determine that a salvaged herd is disease-free?

DOE Reply

A thorough assessment of the hybrid bison population is required to determine if valid representatives of the athabascae subspecies still exist in the area of concern. If so, it would then be possible to identify and salvage them, especially from Wood Buffalo National Park and the Slave River Lowlands. It may be possible in areas adjacent to the park as well, but at greater effort and expense. A thorough assessment of the modern day wood bison gene pool would also be required to determine if salvage of additional stock would enhance genetic diversity of the present day stock. A decision to salvage wood bison phenotypes would be based on several factors, including: availability of valid stock; the merit of enhancing genetic diversity within the wood bison gene pool; the ability to isolate disease-free valid stock, and the costs and practicality of the undertaking.

An initial assessment could be done in the field on free-roaming animals using the phenotypic character index developed by van Zyll de Jong (1986). This method could be supplemented using multivariate morphometric analyses of cranial and post-cranial data following techniques of van Zyll de Jong (1986). This would assess the phenotypic selection, but would also necessitate the killing of animals. DNA fingerprinting or biochemical blood analysis techniques require development or refinement before being useful for distinguishing between subspecies of bison. Ideally, phenotypic and craniometric sampling should occur in four areas across the range of free-roaming bison herds. Presently, the Canadian Parks Service is planning research to develop new techniques to further differentiate bison subspecies at the genetic level. This research may provide more definitive tools for subspecies differentiation by 1991 which could

enhance management of present day bison gene pools.

It would appear that a significant percentage of the genetic diversity of original (pre-1925) wood bison may be preserved in present populations based on a founding herd of 37 animals. However, increasing genetic diversity of existing stocks may provide the subspecies with a greater "flexibility" to respond to environmental changes and to influence its ability to survive in the wild. Addition of 50 to 100 valid wood bison to the present gene pool from an area other than the initial capture site at Nyarling River (e.g. Hook Lake, NWT) could increase the probability of expanding genetic diversity from the original population at large. However, the probability of adding more plains genes to the present day wood bison gene pool should not be overlooked.

When phenotypic assessment is completed and a decision to salvage genetic material is made, it will be necessary to round up and capture wild bison from the area selected. Two possible methods of capture could involve: 1) the use of helicopters and immobilization drugs, or 2) the use of capture corrals, employing techniques of baiting with hay and hazing with helicopters. After animals are live-caught by either method, a rapid card test for brucellosis would be used and all negative bison would be transferred to a specified holding facility. Once in a holding corral, all salvaged bison would be further tested for brucellosis and tuberculosis according to standardized disease-testing procedures and regulations specified by Agriculture Canada. Any positive reactors from tests in the field or in the holding facilities would be disposed of. Only disease-free stock will be maintained in a genetic salvage operation.

The following agencies could be involved with a genetic salvage option: Canadian Parks Service, Northwest Territories Renewable Resources, Canadian Wildlife Service, Agriculture Canada, and the National Museum of Canada. The level of participation and contribution would be subject to appropriate approvals within the mandates of these agencies.

It would be possible to eliminate disease from these herds but under a stringent controlled "testing and slaughter of reactors" program supervised in the park by the Canadian Parks Service utilizing procedures in cooperation with Agriculture Canada. This program would incorporate procedures to permit the successful salvage of wood bison, if such a program was determined to be valid.

Cost information is included in Annex I.

4.3.1.3 Panel Question: By what specific means could complete eradication of diseases and/or hybrid bison be carried out? Assess the feasibility and effectiveness of each plan. What time-frame would be required? Who would conduct a bison depopulation plan? What are the costs associated with each plan?

DOE Reply

It is understood that there are presently no feasible veterinary

treatments for the eradication of either bovine brucellosis or tuberculosis from all free-roaming bison in and around Wood Buffalo National Park. Consequently, the elimination of diseases, where necessary would have to consider the isolation and treatment of smaller numbers of animals and/or the elimination of the animals themselves.

The possible procedures for the salvage and elimination of disease using existing bison has been discussed in responses to sections 4.3.1.1 and 4.3.1.2. Therefore, procedures whereby elimination of bison might occur are discussed below.

If the Canadian Parks Service is instructed to eliminate bison in the park, an innovative, sensible, and humane approach would be required. Reasonable information would have to be obtained on the environmental impact of methods, ecosystem effects and mitigating measures. Notwithstanding the need for future detailing, the folloving may be suitable for use in the eradication of diseases and/or bison.

Ground shooting of free-ranging bison in the region during mid- to late winter appears to be a feasible means to eradicate bison and disease. The major operational difficulty would be complete assurance that all bison in the region are destroyed. In Wood Buffalo National Park, a bison depopulation/repopulation program would be carried out by or under the direction of the Canadian Parks Service.

Eradication of bison in the region is theoretically possible given sufficient resources for several years. Initial depopulation of 90% of bison in the park could take place over a one to ten year period depending upon accepted objectives. It is possible that the remaining 10% of the bison will demand 90% of the depopulation program costs. Mopping-up during subsequent years would be intense until only a small number of bison were spotted and killed. One or two teams, as required, would carry out aerial surveillance, follow-up on bison sightings and eliminate remaining bison. The initial removal program would be followed by periodic intense surveillance with the immediate killing of remaining bison. After a further four consecutive winters without a confirmed bison sighting, the park might be considered free of bison.

Alternative strategies for Wood Buffalo National Park could be as follows:

1) Eliminate bison in the Sweetgrass area starting in the early fall. In winter use fixed-ving aircraft to locate herds in the rest of the park. When bison are located, one large helicopter would go to the scene with a hunting crev and possibly two small over-snow vehicles to aid in dispatching herds.

2) Use hunting teams as per strategy 1 for the entire park. Start with three teams and reduce the number of teams as the herd is reduced.

3) Rebuild and use corrals in the Sweetgrass area. Salvage animals at Sweetgrass with wood bison characteristics as practical and

eliminate the rest.

4) Salvage bison in the northern portion of the park with wood bison characteristics and eliminate the rest. Use corrals in the immediate area to minimize logistical problems.

5) Salvage bison from the park with wood bison characteristics. When an adequate number of disease-free wood bison are confirmed, eliminate the remaining bison.

A depopulation program must include a contingency plan to change methods, increase effort and extend time as required. A program would be conducted during the winter when conditions tend to limit field activities and equipment reliability which would increase costs.

Initially, aircraft would be used to transport crews involved in the depopulation program and for surveillance. One of the required helicopters must be capable of transporting a bison carcass. Carcasses would be relocated from flood-prone areas, wetlands, lakes and watercourses to maintain water quality. On an opportunistic basis, the helicopter may also relocate carcasses for inspection and butchering.

Completion of the above-noted program would require the commitment of the Canadian Parks Service, Alberta and Northwest Territories to ensure the elimination of potentially diseased bison in each jurisdiction on a comparable time-table. The Parks Service would also seek to cooperate and coordinate operations in border regions.

Concerning the practicality and outcome of the process outlined above to eliminate brucellosis and tuberculosis, the latter would be the most difficult to eradicate. This is because the presence of tuberculosis cannot presently be confirmed without a necropsy (Tessaro 1986). Brucellosis can be removed from confined animals (e.x. Elk Island National Park) over a period of several years (Tessaro 1987). Hence, small captive stocks could be retained for brucellosis removal.

The Cree Land Claim Agreement and the Dene/Metis Agreement-in-Principle must be respected where provisions regarding participation in the manipulation of bison and local employment and economic opportunities are applicable. Application of similar principles elsewhere in the park and region are desirable.

4.3.1.5 Panel Question: By what means could wood bison be gradually re-introduced into the Park while disease elimination was underway? Consider the establishment of various-sized contained nucleus herds located in a number of locations in the Park. From where could the bison be obtained? What cost would be associated with each repopulation option? How many wood bison would be required to eventually repopulate the Park? For how long would nucleus herds be contained? What population goals would be set for free-ranging herds? What time frame would be required? What criteria would be used to determine that the range is completely free of bison before a reintroduction of disease-free animals?

DOE Reply

Wood bison used to repopulate Wood Buffalo National Park could come from salvaged disease-free bison, if representatives of the athabascae subspecies are available (see section 4.3.1.2), and from the Wood Bison Recovery Program.

Wood bison from external sources could be gradually reintroduced to Wood Buffalo National Park while the elimination of existing bison was underway by using secure, double-fenced holding corrals. Wood bison could be made available from Elk Island National Park (up to 50 head per year) and the Mackenzie Bison Sanctuary (up to 100 head per year) pending approvals from the GNWT Department of Renevable Resources, the Fort Providence Band, and the Denendeh Conservation Board.

The numbers of wood bison and nucleus herds required will be dependent upon objectives of the park and other cooperating agencies to establish a small free-ranging herd, or to keep larger nucleus herds and gradually release them. Potential locations for nucleus herds are Sweetgrass, Hay Camp, Slave River Lowlands, Garden River and Mile 99. A Sweetgrass location requires a careful evaluation due to potential flooding from the Peace River.

At least two large corral systems with attached enclosures of approximately 100 km^2 each should be constructed in areas of present or former concentrations of bison. Two possible areas are Hay Camp and Sweetgrass where previous disturbance has occurred and where bison densities have been the highest in the park. Initially, corrals at these sites could be used for capture and holding salvaged bison as part of a depopulation process. When the double-fenced enclosures are no longer needed for depopulation and disease-contamination is no longer a risk, the enclosures could be used to maintain and breed disease-free wood bison. In addition to these facilities, two other corral and enclosure systems of a smaller size (10 km^2 double-fenced) could be constructed on the Slave River Lowlands. These corral systems would accommodate genetic salvage if deemed feasible, assist with depopulation of that area, maintain disease-free wood bison initially transferred from source stock, and provide stock for repopulation of the park and the Slave River Lowlands.

The nucleus herds of wood bison would be contained until it is determined that depopulation is complete. It is estimated that a minimum of three years would be required for depopulation, followed by four years of surveillance to ensure that depopulation had been successful. These herds would be held for at least seven years prior to release. The objective would be to release primarily young animals (perhaps at the one to two year age class) for several years until reestablishment is assured. The duration of confinement should be minimized for a variety of reasons including the requirement for feeding.

The population goal set for a free-ranging herd would be identical to that today; that is, the population will be alloved to find homoeostatic balance which will fluctuate with prevailing environmental

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conditions. The time-frame required to obtain repopulation goals, based on population modelling under optimum conditions, is estimated to be between 10 and 15 years depending on reproductive success and mortality rates of reintroduced stock (Annex II). For example, it is estimated that over a ten-year period 140 wood bison per year could be transferred into breeding enclosures to eventually repopulate the park with large herds of wild bison.

As noted above, a suggested criterion to determine if the range is free of disease could be four successive winters of systematic aerial surveillance without sighting bison or bison sign. This would be taken to mean that all existing free-roaming bison had been removed. This state could not be reached unless other jurisdictions remove bison in areas adjacent to the park on a parallel schedule.

See the Bison Disease Task Force Report (1988) and Annex I for cost considerations.

4.3.2 Ecological Considerations

4.3.2.4 Panel Question: What are the potential impacts of bison depopulation/repopulation activities on other wildlife? Consider disturbance from helicopters, airplanes, bison round ups and intensive harvesting of the bison.

DOE Reply

For clarification, the direct ecosystem impacts of the loss of wild bison is not addressed in this response. It is understood that the Panel's technical specialist, as per sections 4.3.2.1. and 4.3.2.2 will address ecosystem impacts. Bison depopulation/repopulation activities have potentially important implications on other park wildlife and their habitat as identified by the Canadian Parks Service environmental assessment procedures (Annex III). A definitive proposal for bison depopulation/repopulation would permit impact identification and qualification. Potential impacts also require further analysis in terms of significance, mitigating measures, and residual effects.

The Canadian Wildlife Service believes that the potential impacts of actions required to depopulate/repopulate bison (i.e. disturbance from helicopters, airplanes, bison round-ups and intensive harvesting of bison) on other wildlife species such as moose, deer, bears, coyotes, foxes, and small mammals are not expected to be seriously detrimental to local populations over the longer term. Temporary local displacement of wild animals from their normal habitat, especially ungulate species, could be expected during depopulation activities. If bison carcasses are left in the field, scavengers such as foxes, coyotes and ravens could temporarily benefit from the added source of carrion.

Moose could be adversely affected by depopulation activities, especially from January through spring, when they are the most vulnerable to stress because of declining body condition. Harassment from January to March could have a significant detrimental impact on

moose. However, because moose are not in high density concentrations throughout the park, anticipated conflicts are likely only in major wintering areas along the south side of Lake Claire and the north escarpment of the Birch Mountains. In general, there is not a great deal of overlap of ranges between bison and moose.

Information on stress in bison from herding, handling and aerial surveys is reported in Stelfox (1976).

4.3.3 Socio-economic Considerations

4.3.3.1 Panel Question: What is the current use of bison for food and economic supplement by members of the communities surrounding Wood Buffalo National Park? How many bison are taken annually? From what areas are the bison taken? What are the projections of future bison use in those communities?

DOE Reply

Currently, no bison are harvested legally in the park. However, bison are harvested when they move outside the park in the vicinity of Fort Smith and in the Garden Creek area.

Following is a summary of information provided by park staff based upon observations over the past five years:

Fort McMurray
- -bison sometimes taken along south boundary of the park

Fort Chipewyan
- -irregular use; 6-12 bison per year
- -opportunistic; prefer moose
- -bison taken in Galoot Lake area outside the park
- -also Rocher River/Flett Lake area occasionally

Garden River area
- -20-30 bison per year
- -opportunistic hunting can be higher
- -prefer moose
- -bison taken west of 5th meridian

Hay River
- -limited opportunity for bison hunting near community

Fort Resolution
- -10-20 bison per year
- -opportunistic hunting
- -bison taken in Slave River Lowlands and Nyarling River areas

Fort Smith
- -30-80 bison taken per year
- -bison actively hunted
- -bison taken in Mission Farms, Little Buffalo and Slave

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River Lowlands areas

Hunting of bison outside the park appears to be steady. If bison population levels continue to decrease then the opportunities for hunting will decline. The number of bison killed illegally in the park is believed to be relatively small and is not included in the above estimates.

4.3.3.5 Panel Question: Identify negative impacts that temporary reduction of bison, from depopulation/repopulation programs in WBNP, may have on tourism and related economic activities?

DOE Reply

See reply to section 3.5.

4.3.4. Regulatory Considerations

4.3.4.1 Panel Question: What regulations apply to the hunting of wood bison in and adjacent to Wood Buffalo National Park and the Mackenzie Bison Sanctuary? Assuming successful repopulation with disease-free wood bison, how will these regulations affect future hunting of wood bison outside WBNP?

DOE Reply

The National Parks Act (Canada 1988) provides the legislation to protect national parks and natural resources therein. Under the Act, the Wood Buffalo National Park Game Regulations (Canada 1987) prohibit the hunting of bison for sport or subsistence purposes within the park.

The Wood Buffalo National Park Game Regulations do not regulate hunting opportunities for wood bison outside park boundaries.

4.3.4.2 Panel Question: What regulatory restrictions would apply to the use of hunting as a means of bison depopulation? How might the regulations be altered to allow for the managed hunting of bison?

DOE Reply

a) Regulatory Restrictions

National Parks Act (Canada 1988) and Wood Buffalo National Park Game Regulations (Canada 1987) prohibit sport and subsistence hunting of bison. Furthermore, the Act stipulates severe penalties for illegal hunting, including:

> (1.2) Every person who, in a park, hunts, disturbs, confines or is in possession of wildlife of any species included in Part II of Schedule II, or who is in possession either in or outside a park of such wildlife killed or captured in a park, is guilty of an offence and is liable (a) on summary conviction, to a fine not exceeding $10,000; or (b) on conviction on indictment, to a fine not exceeding $10,000 or to imprisonment for a term not exceeding six

months or to both.

American Bison (Bison bison) is included in Part II of Schedule II as a protected species.
"hunt" is defined as to kill, injure, trap or capture, to attempt any of the foregoing or to stalk with a weapon.

In addition, Wood Buffalo National Park Game Regulations (Canada 1987) prohibit the public use of firearms in the park. Only holders of Park general hunting permits, which exclude the priviledge of hunting bison, (Section 12.(1)) or those persons authorized to take or kill game for management or scientific purposes (Section 56.(1)) by the Director General may use firearms in the park. The regulations include restrictions on the location of shooting as well as the kind and calibre of firearms. Specific regulations also govern the use and assistance of aircraft for hunting including landings and take-offs.

General Regulations for national parks also contain a number of provisions that relate to hunting activities such as: use of public lands: hazardous activities; restricted activities and areas; preservation of property; aircraft operations; prevention of nuisances; prohibited conduct; and explosives.

b) Alteration of Regulations

While it is technically possible to change regulations, the Canadian Parks Service would not be disposed to the creation of a public hunting program should the decision to depopulate bison be made. The methods used would have to be more sensitive to the intent of the National Parks Act and the objectives of national park protection and management. Factors such as public safety, environmental appropriateness, responsible disposition of bison meat and by-products, and consideration of participants' liabilities would require careful planning. It would therefore be more appropriate to consider existing provisions of the Wood Buffalo National Park Game Regulations (ie. Section 56(1) respecting the taking or destroying of game (wild animals) ... for game management) to develop a program for bison depopulation consistent with redefined park management requirements. Appropriate revisions to the Park Management Plan, including public review and approval by the Minister would also be required. An interagency agreement would ensure depopulation in adjacent jurisdictions on a parallel schedule.

4.3.4.3 Panel Question: Could establishment of short-term captive wood bison nucleus herds in WBNP be carried out within existing Park's regulations? If not, what modifications to the regulations would be required?

DOE Reply

Short-term captive wood bison nucleus herds could be maintained in Wood Buffalo National Park under the present regulations. Significant changes to the regulations will not be required.

In addition, the location and establishment of the nucleus herds would be

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governed by approved Park Management Plan provisions.

4.3.4.4 Panel Question: What regulations apply to the construction of additional infrastructure which may be required to carry out various bison management actions in WBNP (e.g. access roads, corrals, abattoirs, etc.)?

DOE Reply

The Wood Buffalo National Park Management Plan provides overall direction for the protection, management and administration of the park including any construction activities that would be related to the depopulation/repopulation of bison. Such activities fall into the category of non-conforming uses which are not compatible with management objective(s) for a given set of park resources.

Construction of infrastructure required for bison management actions in Wood Buffalo National Park is governed by various Regulations enacted under the National Parks Act (Canada 1988) including:

- -General Regulations (1986)
- -Garbage Regulations (1986)
- -Fire Protection Regulations (1984)
- -Highway Traffic Regulations (1986)
- -Building Regulations (1985)
- -Wood Buffalo National Park Game Regulations (1987)

Waste disposal regulations are currently being developed under Part IV of the Canadian Environmental Protection Act for federal lands, works or undertakings (e.g. landfills, hazardous, and infectious wastes). The Fisheries Act Meat and Poultry Plant Liquid Effluent Regulations may also apply to abattoirs for bison should they be required.

Also, Canadian Parks Service Directives relating to construction activities in national parks would apply and include:

- -1.1.12 Approval of new construction and major alteration projects for fire protection requirements
- -4.8.1 Bridges-trail/inspection, design, construction
- -4.6.7 Construction and operation of back country shelters
- -2.4.2 Environmental Assessment and Review Process
- -1.1.11 Fires- structural
- -4.6.10 Oversnow vehicles
- -1.8.7 Railways, transmission lines and pipelines
- -4.4.10 Sand and gravel pits, quarries and topsoil excavations
- -5.1.3 Transportation of explosive, inflammable or dangerous cargo.

In addition, Policy directs the Canadian Parks Service to take into account in its planning, the full range of implications of any proposed actions on public lands under its administration, management and control. All developments, plans and management activities occurring on national park lands, including those proposed by outside agencies, will be subject to a review process which ensures that the environmental implications are fully considered for decision-making.

4.3.5 Other Considerations

4.3.5.1 Panel Question: Would elimination of the diseased hybrid herd and reintroduction of wood bison affect the designation of WBNP as a World Heritage Site by the United Nations Educational, Scientific and Cultural Organization (UNESCO)?

DOE Reply

There is no precedent to suggest that Wood Buffalo National Park would lose its World Heritage Site designation as a result of the elimination of diseased hybrid bison and reintroduction of wood bison. This is due to the fact that the heritage designation was made on the basis of several outstanding attributes of the Park.

The World Heritage Site nomination (Canada 1978) included recognition of the world's largest free-roaming bison herd. Hybrid wood/plains bison were specifically mentioned in the nomination paper which included a reference to the possibility of intensive manipulation of the bison herd because of the presence of anthrax, bovine brucellosis and bovine tuberculosis or other factors that may significantly decrease the size of the bison population.

The elimination of existing bison (and the bovine disease reservoir) and replacement with wood bison may serve to strengthen the designation of Wood Buffalo National Park as a World Heritage Site. This is because of the potential for the park herd to become the largest free-roaming and self-regulating wood bison population in the world and because of the conservation value in recovering a threatened subspecies. The protection of habitat for populations of rare or endangered species, one of the three criteria of the World Heritage Convention, would occur if disease-free wood bison were reintroduced and preserved in Wood Buffalo National Park.

4.3.5.2 Panel Question: How would elimination of the diseased hybrid herd and reintroduction of wood bison affect designation of the wood bison as a threatened species by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and as an endangered species under the NWT Act?

DOE Reply

Elimination of the diseased bison herd and reintroduction of disease-free wood bison would have a positive effect on the threatened status of wood bison in two respects. First, establishment of another major wild population within the historical range would shorten the time-frame required to remove wood bison from the COSEWIC list of endangered species. This would result in a cost-saving to the recovery program. In addition, this population would receive long-term preservation by being on federal land that is protected under the authority of the National Parks Act. Second, the risk of disease and genetic contamination to free-roaming herds of wood bison would be diminished.

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It is anticipated that wood bison would continue to be listed as an endangered species in the Northwest Territories Act. Hunting of wood bison has taken place in the Mackenzie Bison Sanctuary and occurred prior to the national status change from "endangered" to "threatened" by COSEWIC.

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ANNEX I

COST INFORMATION RELATED TO DEPOPULATION/REPOPULATION OF BISON IN WOOD BUFFALO NATIONAL PARK

INTERIM RISK REDUCTION (Question 3.3)

Wood Buffalo National Park

Assumptions:

-includes a public education program and enhanced monitoring along boundary areas
-right-of-way clearing costs- $1.5-2.5K/ha
-year round, weekly monitoring (minimum) of park boundaries using fixed-wing aircraft; see fixed-wing aircraft costs
-includes use of telemetry to track bison movements
-costs to dispatch bison outside the park boundary not a Parks responsibility

Costs:

Year	Event	PYs	$Cost
1	-planning -interagency agreements	2	$25K
2	-boundary clearing	15	$500K
	-monitoring	2	$50-100K
	-education program	1	$100K
3	-boundary clearing	15	$500K
	-monitoring	2	$50-100K
4+	-monitoring	2	$50-100K
	-boundary maintenance	2	$50K
	5-year total=		$1.325-1.475M

Constraints:

-education program is for a regional audience only
-increasing the frequency of monitoring flights will increase effectiveness
-effectiveness of monitoring reduced due to environmental conditions
-boundary clearing needs to be assessed in terms of creating bison pasture and pathways

BUFFER ZONES/FENCING (Question 3.1)

Assumptions:

-strategically located fences along or near park boundaries to guide bison away from the Mackenzie Bison Sanctuary and agricultural areas
-monitoring program designed rather than arbitrarily structured to detect

and action bison movements; may include on the ground monitoring in accessible areas in winter
-includes the use of telemetry to track bison movements
-monitoring of bison movements in the park is a Parks responsibility
-destruction of bison in buffer zone areas outside the park is a responsibility of Alberta and Northwest Territories
-frenquency of aircraft flights would range from daily to weekly depending on the time of year, weather conditions and the extent of bison movements

Costs:

Wood Buffalo National Park

Year	Event	PYs	$Cost
1	-planning -interagency agreements	2	$.025M
2	-monitor bison movements -purchase fencing materials	8	$1-2M
3	-monitor bison movements -fence construction	30	$2-3M
4	-monitor bison movements -fence construction	30	$2-3M
5+	-monitor bison movements -fence maintenance	4	$.5-1M
	5-year total=		$5.525-9.025M

Region

Mackenzie Bison Sanctuary:

-9 h fixed-wing aircraft per week @ $300/h x 52 weeks	$140,400/year
-technician salary 0.33 PY @ $40K/year	$13,200/year
-doubling this coverage would be more reasonable	$280,800/year
-technician salary	$26,400/year

Hay-Zama Lakes:

-cost to hold and maintain wood bison	$20,000/year
-minimum cost of a buffer zone	
.9 h @ $200/h x 52 weeks	$93,600/year
-technician salary	$13,200/year
-double-fence Hay-Zama enclosure 7 km fence @ $40K/km	$280,000
5-year total=	$1.682-2.450M
Overall 5-year total=	$7.207-11.475M

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Constraints:

-effectiveness of monitoring will be in proportion to effort expended and will be affected by environmental conditions
-availability resources may limit effectiveness of monitoring program
-no guarantee that a buffer zone and barrier fencing will be 100% effective

GENETIC SALVAGE (Questions 4.3.1.1 and 4.3.1.2)

Rough cost estimates for a single site:	$Cost
1. Phenotypic assessment - four areas (Slave River Lowlands and Wood Buffalo National Park) -helicopter time	$ 0.1M
2. DNA fingerprinting - develop and apply techniques	$ 0.1M
3. Sample- 100 animals	$ 0.075M
4. Live capture operations- helicopter method (Slave River Lowlands)	$ 0.1M
5. Live capture- corral method -capture facilities* and operations	$ 0.25M
-bison transportation and maintenance	$ 0.1M
6. Craniometric analyses -20 specimens (cleaning, measuring, assessment)	$ 0.017M
7. Holding facilities* for salvaged bison (costs for one location)	$ 1.0M
8. Operations and maintenance for salvaged bison ($80,000 per year x 10 years)	$ 0.8M
Total=	$2.542M

*facilities also usable for depopulation/repopulation activities.

ERADICATION/REINTRODUCTION OF BISON (Question 4.3.1.3)

Assumptions:

-partial round-up and possible salvage of bison at Sweetgrass
-salvage of bison in the northern part of the park
-research program to be conducted; funded separately
-lov grade road may be required; costs estimated at $12-15K/km
-repopulation using salvaged park bison and introduced vood bison
-salvage of meat not a Parks responsibility
-cost of selecting, holding and transporting vood bison to the park not

included

Logistics:

-park would be divided into zones similar to present bison total count survey; hunting crews rotated through zones according to a schedule
-fixed-wing aircraft would leave Ft. Smith in the morning and search the zone for bison; crew would consist of 1 pilot, 1 navigator/observer, and park staff as observers
-fixed-wing would notify hunting team when bison are sighted; helicopter with hunting team (4 hunters and 2 skidoos) would be dispatched
-hunting team to kill bison; helicopter would search for the next herd
-if carcasses are to be used a second helicopter would taxi skinners to the site and sling the carcass to trucks for transport
-radio-collared bison would greatly assist in the location of bison herds and to track their movements; radio-collared bison would not be killed during the initial depopulation phase unless they moved out of the park

Cost Scenario:

-one hundred bison are killed at or near Sweetgrass during the winter
-carcasses are to be removed
-nearest all-weather road is at Carlson's Landing
-equipment-1 B212 helicopter @ $1700/h + fuel & oil
-1 large truck
-personnel-2 at kill site @ $8/h
-2 at Carlson's landing @ $8/h
-helicopter stationed at Fort Smith due to weather
-personnel to travel to and from the site by helicopter
-return time to kill site from Carlson's Landing is 40 min
-one-way ferrying trip from Fort Smith is 35 min
-winter daylight is 7-8 h
-daily routine-ferry from Ft. Smith- 35 min
-truck leaves Ft. Smith
-bison transported by helicopter
-transport 8 bison with re-fueling- 5.3 h
-return to Ft. Smith
-100 bison/8 bison/day=12.5 days
-cost- helicopter $148,250 + fuel & oil
wages $4,000 + equipment & food
Total $152,250 + above
-cost per bison $1152+20% = $1382

Year	Event	PYs	$Cost
1	-planning -interagency agreement -bison salvage plan -Sweetgrass reconstruction plan	3	$0.1M
2	-build infrastructure -transport corral materials	20	$3.1M
3	-build corral systems		

	-round-up/test/slaughter -50% of herd	80	$2.4M
4	-evaluate salvaging -maintain salvage herd -systematic bison elimination	30	$2.3M
5	-maintain salvage herd -systematic bison elimination -90% of herd	30	$2.2M
6	-maintain salvage herd -systematic bison elimination -holding facility planning	32	$2.2M
7	-maintain salvage herd -systematic bison elimination -planning -build infrastructure -transport corral material -99% of herd	60	$3.5M
8	-maintain salvage herd -systematic bison elimination -interagency agreement -build corrals	60	$3.5M
9	-maintain salvage herd -systematic bison elimination -100%? of herd -introduce wood bison to pens	60	$4.5M
10-14	-maintain salvage herd -maintain introduced herds -bison monitoring/elimination	50	$3.0M
15	-release bison from pens -monitor released bison -bison monitoring/elimination	30	$1.0M
16-?	-random sampling for disease -maintain holding facilities -reclamation -monitor released bison	5	$0.5M
		16-year total=	$28.3M

A major corral was built at Sweetgrass during the 1960's. It was built using: 3.6 m treated posts, 5 x 15 cm planks (6 planks/section), and page wire. Posts are about 2.5 m apart. They were brought in at a cost of $3.30/m. The corral was about 32 km long when completed. The corral is still standing but needs major repairs. A new corral system to the same standard is estimated to cost about $40K/km (posts @ $6.60/m, planks @ $6.00 each).

Fence costs:

-2.1m page wire $15.00/m
-2.1m open plank $33.00/m
-2.1m closed plank $52.00/m

Program Support:

Management and administrative support for an operation of this magnitude will require a support group similar to that of the Wood Buffalo fire control: e.g:

1	program control officer
2	assistant program control officer
1	clerk/receptionist
2	radio operator
1	crew foreman
1	financial clerk
1	storesman
1	assistant storesman
3	labourers
2	truck drivers
Total 15	support staff

Constraints:

-elimination of bison feasible only during winter
-carcasses used from round-ups only
-hunting teams to shoot from the ground only
-helicopters used to transport teams to kill sites
-over-snow vehicles used at kill sites
-estimates based on 1989 dollars
-PYs do not include outside technical experts

Helicopter Costs:

The following information is based upon helicopter requirements and associated costs:

Requirements:

-B212 helicopter with slings, hooks, nets, etc.
-pilot and engineer
-company provides accommodation and transportation for the crew
-Parks provides fuel and oil
-operating season 15 November to 14 April (150 days)
-daily minimum- 6 cumulative hours (total 900 h)

Costs:

-B212 in 1989 cost $1700/h under contract. Cost would be lower because of guaranteed hours and off-season rates. Estimated cost is $1200-1500/h.

-@ $1200/h total cost = $1,080,000

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-@ $1500/h total cost = $1,350,000
-@ $1700/h total cost = $1,530,000

-cost of fuel and oil is extra
-fuel consumption- 2 barrels/h

-other helicopter costs (1989-casual rates):
-206B $650/h
-Hughes 500 $650/h
-ASTAR $725/h
-206L1 $725/h
-204B $1300/h
-205 $1500/h
-212 $1700/h
-contract rates are lower
-+fuel, oil.

Constraints:

-limited daylight in winter
-not operable below -30C
-reduced visibility from clouds, snow and drifting snow
-regular scheduled maintenance
-increased frequency of breakdowns during cold weather
-smaller helicopters cannot move bison carcasses effectively

STUDIES/RESEARCH

Depending upon which option is chosen a number of related studies will be required to provide information for management purposes. Research will be necessary to answer questions and solve technical problems . Monitoring will also be conducted before, during and after any management measures. A concurrent studies/research program will have to be designed to meet these requirements. Elements of this program are as follows:

Status-quo

-design of education program; assessment of effectiveness
-bison movements; telemetry monitoring
-boundary clearing; impacts, effectiveness, succession
-aircraft noise; impacts

Buffer Zones/Fencing

-bison movements; telemetry monitoring
-fencing; impacts, other animal movements
-traditional use activities
-impact on park bison population

Depopulation/Repopulation

-infrastructure; impacts, disturbance, noise
-predator-prey relationships; other prey and predator species
-range studies; vegetation succession

-traditional use activities
-visitation impact, tourism
-impact on bison distribution
-bison genetics
-disease research

Cost:

Ten-year research program estimated at $3-5M.

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ANNEX II

PROJECTED POPULATION GROWTH FOR REINTRODUCED WOOD BISON

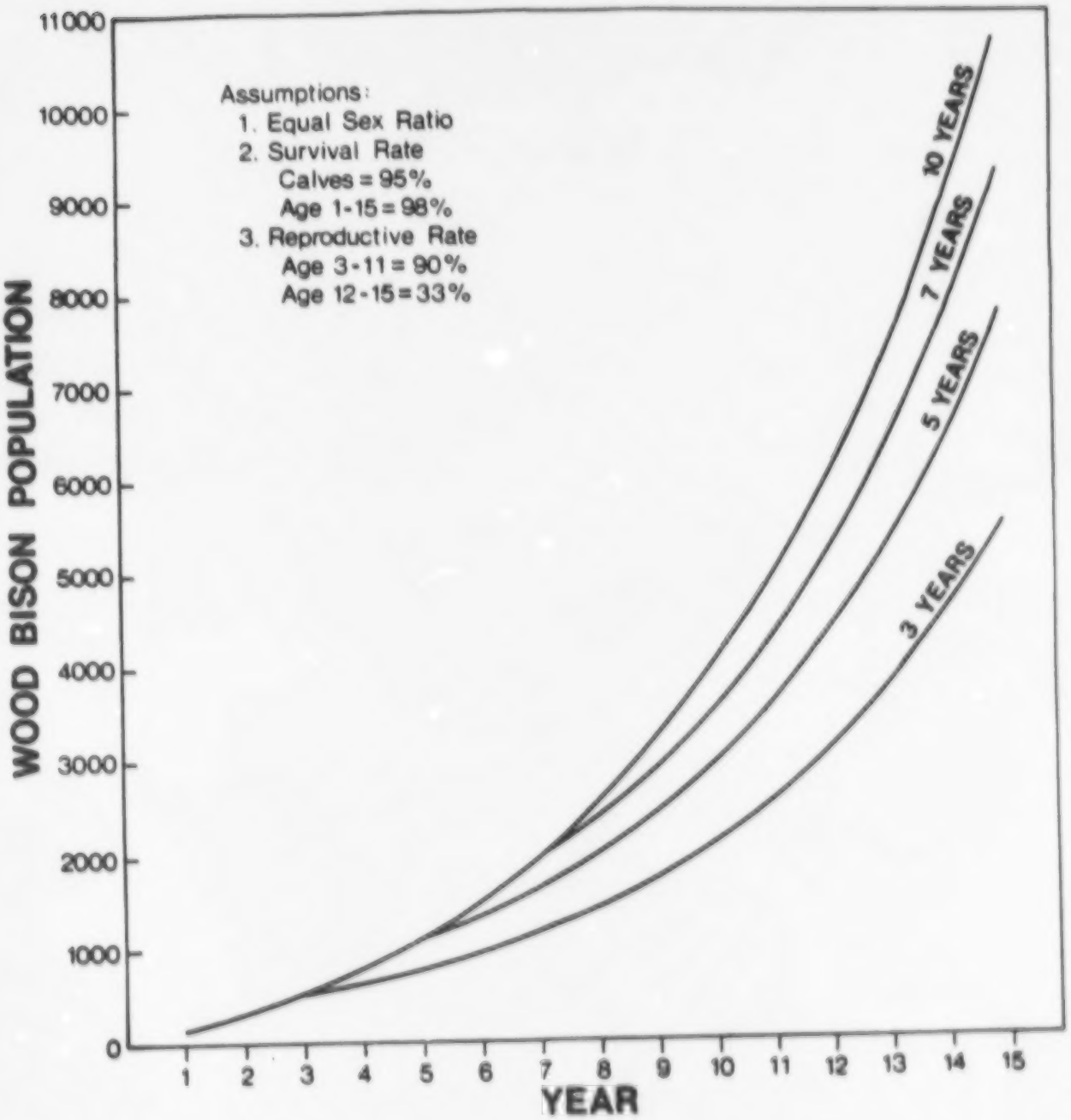

Figure 1. Projected population growth for reintroduced wood bison adding 140 bison per year for 3,5,7, and 10 years.

ANNEX III

POTENTIAL IMPACTS OF BISON DEPOPULATION/REPOPULATION ACTIVITIES ON OTHER WILDLIFE INCLUDING HABITAT

Identified by the Canadian Parks Service following environmental assessment procedures to screen proposed development activities on park lands.

ACTIVITY	POTENTIAL IMPACTS	COMMENTS
	GENERAL	
Access	- includes all aspects of road construction to standards required to support vehicular activities associated with Depopulation/ Repopulation	-rehabilitation to be considered
Roads		
	CONSTRUCTION	
	- removal of vegetation - compaction of soils (despite snovcover) - annual snov compaction by heavy machinery (snov remains longer) - potential effects on wildlife - due to later snov-melt, vegetation species under winter road surface will get a later start in the growing season - effects of construction noise on wildlife (disturbance, leading to possible habitat avoidance) - potential fuel spills leading to habitat degradation (soil, water quality, vegetation) - garbage, littering - road grading - drainage affected - erosion/water quality	-impacts dependent upon road standards used
Access	MAINTENANCE	

	- potential damage to adjacent vegetation, habitat - further compaction of road surface - disturbance to adjacent wildlife (noise, presence of machinery) - potential for fuel spills	
	USE BY VEHICLES	
	- potential damage to adjacent vegetation, habitat, if off-road use occurs - road surface compaction - dependent on level of traffic, disturbance to area wildlife from noise - potential mortality of wildlife (vehicle-related) - emission of exhaust by vehicles (air quality) - possible fuel spills - compaction of soils - damage to vegetated areas under road surface - release of hazardous materials (spills) at re-fuelling locations, vehicle maintenance sites	-mitigation by regulation
	CUMULATIVE/ADDITIVE EFFECTS	
	- additive area impacts in relation to other roads and other elements of Depopulation/Repopulation	
Access		
Trails	- level of impacts is dependent on the trail standard used i.e. for vehicles or for pedestrian use - impacts are similar to roads	
	CONSTRUCTION	
	- ground disturbance, vegetation removal/damage - soil compaction, erosion	

	potential, water quality - wildlife disturbance	
	MAINTENANCE	
	- further ground compaction, vegetation damage, wildlife disturbance	
Access		
Aircraft - Fixed-wing	FACILITIES	
	- vegetation removal, ground levelling/compaction - wildlife displacement, habitat destruction - potential for fuel spills - maintenance area waste disposal, garbage accumulation	- among other mitigation measures, rehabilitation to be addressed
- facilities required for this activity include landing strips, fuel caches, maintenance areas		
	FLIGHTS	
- may also include floatplane facilities ie. docks, if spring/fall/summer activity to take place	- dependent on altitude, varying levels of noise will be experienced by wildlife at ground level - disturbance/stress to terrestrial and avian species - may affect habits (flight, habitat avoidance) - potential impacts will be magnified at take-off/ landing sites - possibility of accidents - impact on whooping cranes during spring/summer	-overflight restrictions to apply
	IF FLOAT PLANES USED - may affect water quality at refuelling locations ie. spills	
Access		
Aircraft - Rotary-wing	- impacts are anticipated to be similar to those generated by fixed-wing aircraft	
- on ground		

facilities are expected to include landing pads, fuel caches, maintenance areas	
Access	GENERAL
Vehicles	1) - a universal impact generated by all these types of vehicles is noise - noise may cause disturbance to wildlife leading to habitat avoidance, possible habitat changes, and, in general, stress - the possibility exists that any vehicle may be used to harass wildlife 2) - fuel caches and re-fuelling may result in spills (soil/water quality affected) 3) - vehicle maintenance areas may be associated with vegetation damage, water quality deterioration, garbage and waste build-up 4) - soil compaction not only on road/trail surfaces, but also if used off-road 5) - vegetation damage directly (snow compaction, resulting in later spring-melt, resulting in later growth initiation, or mortality) 6) - cumulative effects of several types of vehicle activity in conjunction with all other ground and air activities
Communications	
- likely need to set up radio towers, antennae	- physical ground disturbance - vegetation removal, damage - since equipment will

	likely be flown into some locations, noise and other impacts attributable to aircraft will be included - if Depopulation/ Repopulation is long-term, further impacts similar to the above may be generated during maintenance of communications equipment
Camps - includes all aspects and infrastructure ie. - kitchen, administrative, maintenance, sewage, sleeping, garbage, etc. facilities	OVERALL IMPACTS -impacts of camp facilities dependent on size and duration/frequency of occupation of the camps (vegetation removal/damage, ground compaction, drainage alteration). Also: disturbance of wildlife, destruction of habitat and displacement of wildlife KITCHEN - improper food storage/ handling may attract wildlife, leading to habituation or potential human/bear conflicts - improper disposal of kitchen wastes may have same impacts as above in addition to affecting soil/water quality at disposal site - garbage may attract wildlife SLEEPING & ADMINISTRATIVE - see overall impacts (above) SEWAGE - dependent on quantities generated and effectiveness of disposal, may affect soil and ground water quality, vegetation - may attract wildlife

	GARBAGE
	- may attract wildlife
	HEATING
	- fuel used may be improperly stored or handled, resulting in possible spills leading to contamination of soils/water with resulting detrimental effects on wildlife
Depopulation	Note This activity is stratified under two categories: 1) those aspects of activities having potential impacts on Bison; and 2) those aspects of activities with potential impacts on other wildlife
	BISON
Locating	- stress due to harassment - disruption of habits/ habitat use (feeding, resting etc.) - possible mortality/ injuries due to evasive action - the above reactions can be attributed to noise and aspects of this activity directly focused on the animals
	OTHER WILDLIFE
	- disturbance of habits/ habitat use, stress, harassment - mortality, injuries
Baiting	BISON

	- use of hay bales may introduce exotic species of vegetation - concentrates Bison at specific sites leading to trampling of ground surface, vegetation impacts, exposure to predators	-alfalfa will mitigate the concern
	OTHER WILDLIFE	
	- attracts predators to baiting stations (possible habituation)	
Round-up	BISON	
	- stress, leading to possible injuries, trauma and mortality - trampling of vegetation, soil compaction	
	OTHER WILDLIFE	
	- stress, habit/habitat use changes	
- Holding	BISON	
- Quarantine	- stress, possibility of injury, mortality - vulnerability to predators	
- Segregation Holding for Re-introduction	OTHER WILDLIFE	
	- displacement of wildlife from area used for holding	
	OTHER	
	- sewage/waste build-up and disposal problems at holding site - trampling/destruction of vegetation/ground surface - introduction of exotics via feed used for Bison	
	GENERAL	

	- build-up of carcasses attracts scavengers, affects soil/water quality - activity of elimination stresses/traumatize Bison - stresses of previous may also be evident in other species in the area - noise and other activities associated with elimination stress other wildlife, affect habitat (see Access) - cumulative overall effects
Clean-up/Removal (carcasses) - shipping/removal	- see impacts listed for access/camps
Monitoring Thoroughness of Depopulation	- see impacts listed for access (especially aircraft)
Decrease in Bison (Depopulation)	- activities associated with depopulation can be expected to introduce varying levels of stress habit/habitat use changes in other species of wildlife - potential decrease in predator and scavenger populations - potential shift of predator focus onto other potential prey species with resultant decrease in moose population - ungulate populations may be affected in similar way as moose - potential changes in habitat may involve species composition changes with the removal of the Bison grazing influence

Indian and Northern Affairs Canada
Affaires indiennes et du Nord Canada

Deputy Minister
Sous-ministre

Ottawa Canada
K1A 0H4

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OCT 10 1989

Mr. R.G. Connelly
Chairman,
Northern Diseased Bison Environmental
Assessment Panel
Federal Environmental Assessment Review Office
Fontaine Building, 13th Floor
Hull, Québec
K1A 0H3

Dear Mr. Connelly

Northern Diseased Bison Environmental Assessment Panel

Thank you for your letter of 27 July, 1989 outlining the above Panel's information requirements for the review of management options for the diseased bison in and around Wood Buffalo National Park.

In our review of your questions and responsibilities as they relate to the issues the panel raised, we feel that our department's input pertains mainly to socio-economic considerations. From this perspective the long-term resolution of disease problems in the herd would certainly facilitate the planning of economic development projects involving bison in the area, particularly those projects related to tourism and hunting, as well as the use of bison for subsistence purposes.

In regard to Section 4.3.3.1, it is my understanding that the Alberta Government and the Government of the Northwest Territories will be providing information on the use of bison by communities surrounding Wood Buffalo National Park.

Section 3.5 requests information on the potential impacts of the diseased animals on the development of industries such as game-ranching. The Fort Smith Hunters and Trappers Association has proposed a game-ranching pilot project, the "Hanging Ice Bison Ranch". The proposal requests some $325,000 in federal government funding through the Economic Development Agreement. If the project were to go ahead the contributors and proponents of the project would have an interest in ensuring that the herd, brought in from Elk Island, would remain disease free. Double fencing is being contemplated to minimize disease transmission, at an estimated cost of $153,000.

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It may be useful for the Panel to be advised of the following:

1. The Cree Band of Fort Chipewyan Treaty 8 Settlement Agreement provides for Wildlife Harvesting Rights. In particular, Schedule 1 of the Agreement provides for Indian participation on a Wildlife Advisory Board. Schedule 6 refers to wildlife harvesting rights on tradition homelands, which includes the national park.

2. Approval has been given by the department for the Little Red River Band to pursue the creation of a reserve within the current park at Garden Creek near the western boundary. Band members residing at Garden Creek will have a particular interest in the outcome of the panel review as the park would ultimately surround their reserve. As well, Alberta Region has committed funds to the Little River Band for environmental activities. Some of the funds may be used to address issues implicit in the public participation portion of the panel review.

3. The Agreement-in-Principle for the Dene/Métis comprehensive land claim provides for the Dene/Métis to have a co-management role in wildlife issues both within the Park and in the surrounding area.

Finally, given Indian use of traditional homelands and the example of the Cree Band Settlement Agreement, it would be useful for the Panel members to consider the involvement of band representatives in any management option decided for the bison.

I hope this information is useful. If you need further information, the departmental representative is:

Mr. Keith MacDonald
Head, Land Data and
Transactions Services
Lands, Revenues and Trusts
Indian and Inuit Affairs
Alberta Region
(403) 495-4145

Sincerely yours,

Harry Swain

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Alberta
HEALTH

Seventh Street Plaza, 10030 - 107 Street, Edmonton, Alberta, Canada T5J 3E4

FEARO
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FYI

In Replying Please Quote

September 7, 1989

Mr. R.G. Connelly
Chairman
Northern Diseased Bison
Environmental Assessment Panel
Federal Environmental Assessment
Review Office
Fontaine Building, 13th Floor
Hull, Quebec
K1A OH3

Dear Mr. Connelly:

Re: Northern Diseased Bison Environmental
Assessment Panel "Information Requirements"

Please excuse the delay in my response to your letter of July 27, 1989 to Mr. Rheal Leblanc, Deputy Minister, Alberta Health requesting our comments. I have been out of the country and have only just now had a chance to reply.

You should already have received a reply from Dr. Anne Fanning, Director of Tuberculosis Services concerning the tuberculosis aspects of the problem. I will, therefore, confine my remarks to the brucellosis and anthrax aspects of the problem except to note that the greatest potential risk of human exposure to animals infected with tuberculosis would probably be individuals who slaughtered and butchered the infected animals. (In the human setting, the greatest risk of transmission to health care workers is encountered by those performing autopsies on infected persons). I will also restrict my comments to implications for human health.

Brucellosis is transmitted to people by direct contact with tissues, blood, urine, vaginal discharges, aborted fetuses and placentas from infected animals. Transmission may occur by inhalation of or contact with mucous membranes or through breaks in the skin with these infected materials. Ingestion is another means of spread but this appears to be primarily related to ingestion of unpasteurized milk or cheese and hence not likely to

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be a problem with the infected bison. In our experience it is only persons with direct contact with infected animals and their discharges or waste who become infected (other than by ingestion of milk or cheese). Thus it is farm hands, veterinarians and abattoir workers who are at most risk where there are infected animals.

In the current situation, there is, therefore, the potential for human infection from infected bison but this would be confined largely to persons slaughtering and butchering infected animals or anyone who might be in contact with pregnant animals who abort. Risk to persons handling or eating meat from infected animals is theoretically possible but this possibility is extremely remote. Exposure of humans would be highly unlikely unless animals were being slaughtered (as a result of a culling operation or poaching) and butchered or if animals strayed from the park and infected domestic animals.

There is <u>no</u> evidence that this theoretical risk has ever materialized in Alberta. We have very few cases of brucellosis each year (0-6 cases per year in the past decade, median 1) and most are imported cases. None of the indigenous cases has occurred anywhere near Wood Buffalo National Park and none has had any contact with animals from the park.

Similarly, we have had few human cases of anthrax in Alberta and none has in any way been linked with the Park. There could be a <u>potential</u> risk to persons handling hides from infected animals or exposed to soil contaminated by the carcasses of diseased animals.

In summary, the infected bison in Wood Buffalo National Park could constitute a theoretical or potential risk for tuberculosis, brucellosis and anthrax to people but there is no evidence that this has ever occurred. No specific action for protection of humans would be required if the herd was to be left as it is.

A decision to remove the herd and replace it with disease free animals would remove the potential risk to humans and might be desirable from an animal health or environmental point of view. However, the risk to humans does not appear to be sufficiently high for it to be a factor in any decision about managing the herd.

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cont.../3

I hope these comments are useful to you. Please be free to contact me if I can add anything further.

Yours truly,

J.R. Waters M.D., F.R.C.P.(C)
Director, Communicable Disease
Control and Epidemiology

/nr

c.c. Mr. R. Leblanc
c.c. Dr. K.W. Hodgins

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Alberta
HEALTH
Tuberculosis Services

Our File No.
Your File No.

Aberhart Hospital, 114 Street and University Avenue, Edmonton, Alberta, Canada T6G 2J3 403/422-2444

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August 28, 1989

Colin D. Lachance
Executive Secretary
Northern Diseased Bison
Environmental Assessment Panel
Federal Environmental
Assessment Review Office
510 - 750 Cambie Street
VANCOUVER, B.C.
V6B 2P2

Dear Mr. Lachance:

RE: WOOD BUFFALO BISON TUBERCULOSIS THREAT TO HUMANS

Tuberculosis Services of Alberta is aware of the high rate of tuberculosis in Wood Buffalo bison. The 1987 PhD thesis of Dr. Stacy Tessaro, demonstrated 21% of 72 bison carcasses to be infected with tuberculosis. Seven of the 15 carcasses grew Mycobacterium bovis. Dr. Tessaro estimated a tuberculosis prevalence in the Wood Buffalo bison of 32%.

The transmission of tuberculosis in man is believed to be from human to human. When an individual with a productive cough expels droplets of sputum containing Mycobacterium tuberculosis, the organisms which remain suspended, may be inhaled by those breathing the contaminated air.

Most contacts of infectious cases are household members, or those with prolonged indoor contact. Hence, it is difficult to imagine a coughing bison could infect a human.

Nonetheless the mode of transmission in animals is believed to be both airborne and by fecal-oral spread, or by ingestion of contaminated milk. This raises the possibility of ingestion as a mode of spread from animal to man. Dr. Tessaro demonstrated hunter butchering of 9 of the 15 tuberculosis infected bison.

.../2

For zoonotic infection to occur, man would have to ingest inadequately cooked animal organs, heavily infected. From Dr. Tessaro work, lymph nodes and lungs are most commonly involved. Muscle is seldom involved. However, when disease is disseminated, organisms spread via the bloodstream. Hence, it is possible that meat would be contaminated with organisms.

If such meat were prepared by drying, organisms could survive. Upon ingestion by humans of this hypothetical product, gastric juices would not destroy the organism. In man, mycobacteria can be cultured from the stool of humans with pulmonary tuberculosis, who swallow their sputum. Bowel lesions in man are, however, rare. They account for only approximately 1% of all cases of tuberculosis The pathogenesis of bowel lesions may be by hematogenous dissemination from a lung primary infection. However, invasion of the bowel wall may occur. But, the fact that bowel lesions in man are most frequent at the ileocaecal valve where transit is slower, is suggestive evidence for such a route of infection.

In Alberta in the past nine years there have been 42 cases of abdominal tuberculosis (2-3% per year). Only one of these occured in the two northern Health Units bordering Wood Buffalo National Park (fig 1). Rates of tuberculosis in Alberta are highest in Treaty Indians (fig 2). However there does not appear to be a preponderance of cases of pulmonary tuberculosis in the area adjacent to Wood Buffalo National Park (fig 3).

The cost to Alberta Health Care of animal to man transmission of tuberculosis apppears to negligable. Containment of such zoonotic transmission of infection would be by elimination of ingestion of contaminated animal products by man. The attempt to regulate sales of such products appears to be difficult. A program of education to outline the risk would seem the most appropriate direction to take.

Yours truly

Dr. E. Anne Fanning
Director
Tuberculosis Services

/bh
c.c. Dr. John Waters
Att.

Figure 1

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High Level HH

Fort McMurray HH

• Reserves

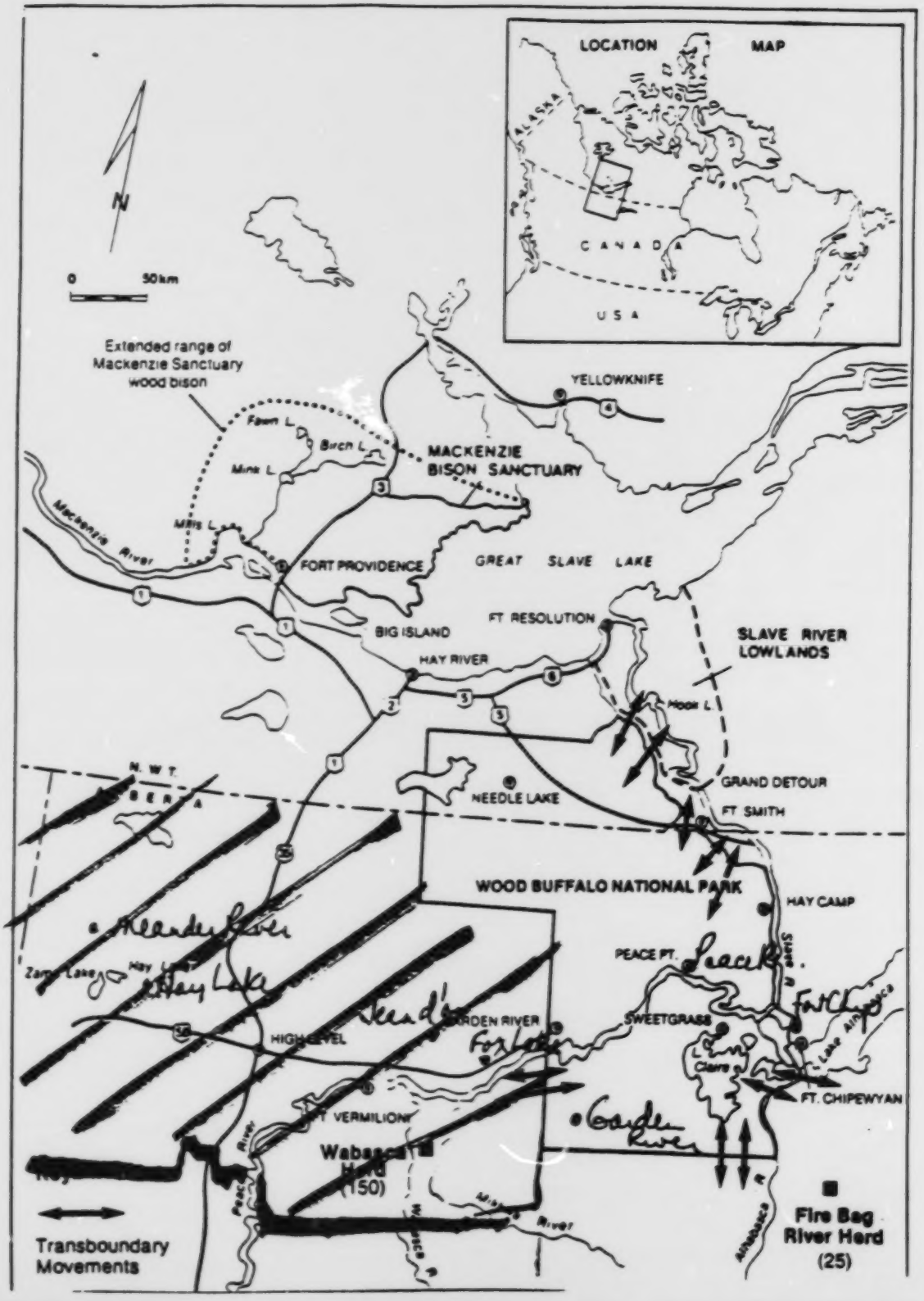

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Figure 7

TUBERCULOSIS RATES PER 100,000, ALBERTA CANADA

YEAR	NUMBER OF CASE REPORTS	OVERALL RATE	NUMBER OF CASE REPORTS	TREATY INDIANS
1976	233	12.5	57	170
1977	280	15	65	195
1978	245	12.5	54	153
1979	231	10.5	78	159
1980	259	11.9	43	107
1981	244	11	45	112
1982	211	10	53	132
1983	189	7.5	49	122
1984	221	9.8	46	115
1985	178	7.6	33	82
1986	209	8.8	48	97
1987	205	8.7	77	152
1988	176	7.4	45	91

Figure 3

RATES OF TUBERCULOSIS BY HEALTH UNITS

HEALTH CENTRES BORDERING WOOD BUFFALO NATIONAL PARK

YEAR	ALBERTA		HIGH LEVEL FORT VERMILLIN		HEALTH CENTRES NEAR WOOD BUFFALO NATIONAL PARK		FORT MCMURRAY		FORT CHIP	
	NO.	RATE	NO.	RATE	NO.	RATE	NO.	RATE	NO.	RATE
1988	176	(7.4)	1		6		3			
1987	205	(8.7)	0		4		7	(16)	1	
1986	209	(8.8)	1	(6.9)	2		9	(23.2)	1	
1985	168	(7.6)	0		1		6		2	
1984	221	(9.8)	1		0		8		1	

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Alberta
AGRICULTURE

Office of the Deputy Minister
7000-113 Street, Edmonton, Alberta, Canada T6H 5T6 403/427-2145

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Ref:
SEP 22 1989
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September 14, 1989

R.G. Connelly, Chairman
Northern Diseased Bison
Environmental Assessment Panel
Federal Environmental Assessment
Review Office
Fontaine Building, 13th Floor
Hull, Quebec
K1A 0H3

Dear Mr. Connelly:

NORTHERN DISEASED BISON ENVIRONMENTAL ASSESSMENT PANEL

In reply to your request for our response to the Panel's "Information Requirements", I am enclosing a document entitled "Alberta Agriculture Response to the Northern Diseased Bison Environmental Assessment Panel". Please consider this document to be our position on the issues raised.

I sincerely hope that the deliberations of the Panel will lead to a satisfactory resolution of the problem of free-roaming diseased hybrid bison in northern Canada for the benefit of both the livestock industry and wood bison recovery efforts.

Yours sincerely,

H.B. McEwen

Encl.

cc: J. Harold Hanna
Terry Church

ALBERTA AGRICULTURE RESPONSE TO THE NORTHERN DISEASED

BISON ENVIRONMENTAL ASSESSMENT PANEL

3.1 The status quo is not acceptable. The risk reduction measures taken by Alberta Agriculture will be to insist that Agriculture Canada maintain testing and surveillance programs and control over the movement of cattle and game farmed animals in northern Alberta. We will encourage livestock producer groups to lobby for continuation of disease control programs and for appropriate actions to fully resolve the problem. Depopulating the small resident herds of bison around the periphery of WBNP is being discussed by Alberta Fish and Wildlife with Agriculture Canada as a risk reduction measure.

3.2 Alberta Agriculture has been aware of the risk of disease transmission from the diseased bison in WBNP for some time. As Canada progressed towards complete freedom from brucellosis and tuberculosis, both the risk and consequences of spread of these diseases became much more significant. We have fully participated in discussions with Agriculture Canada since the mid 1980's seeking a resolution to the problem.

The risk reduction measures outlined above will, at best, be only partially successful because the risks to agriculture are both the actual and the perceived threat of disease spread to cattle or domestic bison herds. If adequate resources are provided for disease surveillance and testing, the actual risk of transmission of brucellosis and tuberculosis to livestock is reduced but not eliminated. As long as the threat of transmission remains, Alberta's livestock export markets are in jeopardy and our international reputation as producers of high quality livestock is tarnished. Therefore the status quo or present situation is not acceptable.

3.3 The ongoing costs of disease surveillance and testing will be supplied by Agriculture Canada.

3.4 The costs associated with the transmission of either brucellosis or tuberculosis, or both, from the infected bison population to domestic cattle are variable and complex.

The costs to farmers would include the disruption in their operations due to quarantine, testing and depopulation. This may involve the loss of valuable breeding stock built-up over a long period of time. While farmers would be compensated by Agriculture Canada for direct losses, there is no compensation for the loss of marketable animals and the trouble and expense of assembling a new herd.

However, the more significant cost of disease transmission to domestic cattle to farmers is the effect on domestic and international markets. Domestic markets could be adversely affected if the public loses confidence in the wholesomeness and safety of meat products. Packing plant worker unions may perceive that processing infected or potentially infected animals constitutes a threat to the health of the workers and refuse to handle them in the slaughter plants. International markets would be significantly threatened by embargoes on livestock meat, semen and embryos. Out of province shipments of meat, animal products and live animals from Alberta in 1987 was $1,336 million. The out of country exports of these products was $332 million.

In the short term, there would not likely be any significant costs to the consumer, especially with a small outbreak. However, a major outbreak which resulted in international trade embargoes on Canadian livestock or livestock products would be devastating for the livestock industry. The consumer may ultimately end-up paying significantly more for these products due to the over-reduction in supply in reaction to the embargo. This effect was clearly demonstrated following the foot and mouth outbreak in Saskatchewan in 1952.

3.5 In addition to the negative impacts identified in 3.3 and 3.4, the presence of brucellosis and tuberculosis in the bison in and around WBNP will necessitate increased disease surveillance and control of movement of domestic livestock and game farmed animals into and out of the north Peace area. This will serve to discourage expansion of production and limit the producer's flexibility. The north Peace is an area which would benefit significantly from increased livestock production since much of the remaining agricultural land in the area is well suited to forage production. The climate and soil types place limitations on the suitability for producing cereal and oilseed crops.

4.1.1 Until the risk of disease transmission from infected bison in northern Alberta is eliminated, Alberta Agriculture will insist that Agriculture Canada maintain adequate measures to ensure that brucellosis and tuberculosis can not spread into the rest of our domestic cattle or bison herds. Depopulation of the small bison herds outside of the park will be pursued as soon as feasible to reduce the risk of spread of diseases.

4.1.2 The surveillance and control measures provided by Agriculture Canada can not effectively prevent the spread of diseases from the free-ranging, infected hybrid bison to domestic cattle or bison in the Fort Vermilion area. However, disease control measures could be quite effective in preventing transmission from infected cattle to other cattle outside the region.

4.1.3 The costs of this measure will be supplied by Agriculture Canada.

4.2.1 A critique provided by Agriculture Canada has shown that the diseased, hybrid bison in WBNP can not be adequately contained by a fence or buffer zone and details the reasons. Our position would not be altered by a fence or a buffer zone and Alberta Agriculture would continue to insist that an adequate testing and surveillance program be maintained for cattle and game animals in the north Peace region.

A buffer zone of sufficient size to be effective, (ie. 320 kms) around WBNP is entirely out of the question. All cattle and domestic bison north of Manning would have to be removed. This is not possible because there is no existing legislation to effect this removal. There would be tremendous opposition to the passage of any such legislative authority in Alberta. There are other compelling reasons why a buffer zone outside of WBNP can not be considered. Agriculture and cattle-raising has a historic precedence in the area over the park and the diseased bison. In fact, Fort Vermilion is the oldest agricultural settlement in Alberta, dating back to 1788. The Fort Vermilion area contains a significant amount of deeded land on which people have the right to pursue agricultural endeavours of their choosing. Proposals for a buffer zone around WBNP simply transfers the problem to Alberta. Alberta already has a great amount of land devoted to national parks and the problem of diseased hybrid bison properly belongs to WBNP.

The risk to cattle and bison has increased substantially in recent years due to the continued natural agricultural development in the north Peace area and progress towards brucellosis and tuberculosis free status in Canada. One of the conventional approaches to disease control is keeping the diseased animals away from the healthy ones. In this case, a buffer zone is quite fallacious because it would attempt to keep healthy animals restricted from an area where they have legitimate right to be, in order to keep them away from diseased animals.

Due to forest fires, snow, floods and the action of man, the integrity of a fence to contain the diseased hybrid bison can not be assured. The feasibility of a double fence to contain the diseased bison is limited by the technical difficulty of construction in this rugged terrain and the crossing of major rivers and lakes, the very high initial cost, annual maintenance costs and the cost of replacement every 25 to 30 years. The costs would be millions of dollars and if just one diseased bison escapes, all is lost.

4.3.1.3 Experience in other areas of the world strongly demonstrates complete eradication of diseased and/or hybrid bison could be successfully carried out by a combination of capture, field slaughter and supervised hunting. Eradication of all of the bison in and around WBNP is entirely feasible and would be 100% effective in removing the risk of spread of diseases. A complete depopulation of the bison in and immediately around WBNP should be under the direction and supervision of Agriculture Canada.

It has been recommended that the bison in and around WBNP could be completely depopulated over ten years. The project would require a permanent federally-inspected slaughter plant with adequate frozen storage capacity and rendering facilities as well as a mobile or portable abattoir facility. The bison would be depopulated by capturing and transporting as many as possible for processing at the federally-inspected slaughter plant.

Since it is clearly recognized that it will not be possible to capture and transport all of the bison, a mobile abattoir would be used to field slaughter bison in WBNP. Approved carcasses and offal and condemned carcasses would be transported to the permanent storage and rendering facility. The outlying and peripheral herds would be depopulated by supervised hunting and field inspection of the carcasses. Meat which passes inspection would be sold through existing market channels.

In order to facilitate the capture and transport to slaughter, holding and handling corrals would be constructed at suitable locations such as Sweetgrass and Hay Camp or Pine Lake. The movement of bison during the winter months into these holding corrals would be assisted by various combinations of wing fences, baiting with hay, plowed trails and controlled hazing by land vehicles or aircraft. Radio collaring of a few bison may be employed to assist in the location of the various herds.

It is predicated that depopulation of the majority of the bison herd could be achieved over three to four years. Extensive aerial surveillance would be required for six to seven years to ensure 100% depopulation. It has been estimated that a complete depopulation and repopulation of WBNP with disease-free wood bison could be achieved for $20-22 million.

Reference: A Proposed Course of Action to Replace Disease Exposed Bison in Northern Canada with Disease Free Wood Bison / Agriculture Canada.

4.3.1.4 Since WBNP is mostly located in Alberta, bison meat and by-products could be handled under the authority of Agriculture Canada or Alberta Agriculture. Agriculture Canada provides full federal meat inspection services which would allow sale or distribution in any province or territory or exported to other countries. However, federal inspection would also require construction of a slaughter facility at a estimated cost of $2.5 million. Bison would have to be captured live and transported to the facility.

Under the Alberta Meat Inspection Act, bison could be processed in mobile or permanent slaughter facilities estimated to cost about $0.5 million. These facilities would have to be located in Alberta and the meat could only be sold in Alberta.

Hides and other by-products could be sold through existing market channels. A rendering plant, estimated to cost $1.5 million, in the vicinity would be required for disposal of offal and condemned material.

Reference: A Proposed Course of Action to replace Disease Exposed Bison in Northern Canada with Disease Free Wood Bison / Agriculture Canada.

4.3.5.3 Specific monitoring procedures required during and after repopulation with disease-free bison would be required. During repopulation with wood bison, their health status should be monitored by post mortem examinations of any animals which are found dead, by periodic testing for brucellosis and tuberculosis and testing of all bison for freedom from these two diseases before release into WBNP.

After wood bison have been released into WBNP, ongoing surveillance by post mortem examinations and periodic sampling of immobilized animals or those shot by hunters outside of the park is required. Once freedom from brucellosis and tuberculosis has been assured, the testing and surveillance of cattle and domestic bison herds in northern Alberta is no longer necessary.

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Alberta
FORESTRY, LANDS AND WILDLIFE

P.E.A.R.O.
B.P.E.E.E.
File/ Ref:
REC'D / REÇU

Office of the Assistant Deputy Minister
Fish and Wildlife Division

Petroleum Plaza, South Tower, 9915 - 108 Street, Edmonton, Alberta, Canada T5K 2C9 TWX 037-3507 403/427-6749

D/R 452-89/90

September 14, 1989

Mr. R.G. Connelly
Chairman
Northern Diseased Bison Environmental Assessment Panel
13th Floor, Fontaine Building
Hull, Quebec
K1A 0H3

Dear Mr. Connelly:

Please find attached the Alberta Fish and Wildlife Division's response to the request for information by the Northern Diseased Bison Environmental Assessment Panel. I hope this information fills the gaps the Panel identified. If not, please feel free to contact either Bill Hall or Bob McFetridge for further information.

Yours truly,

L.J. Cooke
Assistant Deputy Minister

cc: R.R Andrews
W.K. Hall
R.J. McFetridge

Attachment

ALBERTA'S FISH AND WILDLIFE REPLY TO

NORTHERN DISEASED BISON ASSESSMENT PANEL INFORMATION REQUIREMENTS

3.0 CURRENT STATUS

3.1 If the current status is maintained:

Under a status quo regime Alberta Fish and Wildlife will terminate all projects relating to the recovery of wood bison in northern Alberta by curtailing its reintroduction programs.

As we do not want to place ourselves in the position that the Northwest Territories government presently finds itself. That being one of having a large population of diseased free wood bison which are in danger of becoming diseased plus having hybridization occur.

We would remain concerned with the spread of disease to other wildlife even though the chances of that happening are relatively small.

Genetic contamination would no longer be a direct concern to us but we would continue to be concerned with the situation in the Northwest Territories (McKenzie Bison Sanctuary).

3.2 Termination of the Reintroduction Program would occur with the removal of the bison being held at Hay-Zama to a site outside of Alberta.

3.3 Cost associated with maintaining the bison at Hay-Zama is about $25,000 per year. There would be a $50-$60,000 cost associated with the removal of the Hay-Zama herd.

3.4 In light that we have taken no protective measures there would be no dollar cost to Alberta Fish and Wildlife. Potential loss costs would be in the area of recreational opportunity, social, economic and subsistence benefits to Albertans if disease free wood bison herds were not established across Alberta. Potential benefits may be related to bison herds as large as 4,000 animals outside of Wood Buffalo National Park.

3.4.1 Disease Transmission: If these diseases are transmitted to other wildlife such as moose and caribou, there would be a loss in animal numbers (brucelosis is terminal in moose), and a reduction in subsistence and recreational hunting.

3.4.2 Genetic contamination of the McKenzie Bison Sanctuary herd would result in cancellation of recovery plans for the wood bison sub species including those in Alberta.

3.5 Under the status quo it is assumed that bison would not be allowed to expand freely outside Wood Buffalo National Park. Therefore there would be no tourism and the risk to cattle ranching and game farming would always be present as would the need for controlling diseased bison dispersal.

4.0 Management Action

4.1 Interim Protection Measures

4.1.1 We will be terminating the reintroduction of wood bison as an interim measure until diseased bison are eliminated.

We would participate as a team member in the replacement option and believe that relevant tasks would be assigned to this division regarding the removal and monitoring of bison on provincial lands. We do not see ourselves participating in other options.

Alberta would contribute to the wood bison recovery by reinstating objectives at Hay-Zama and extending bison objectives eastward to the Park boundary across northern Alberta.

4.1.2 The feasibility of bison removal outside of Wood Buffalo National Park on Alberta land is a moot point. This issue is one that raises the most doubts in discussions of the replacement option.

The depopulation is feasible but it is important to have an understanding of the following:

1. bison behavior
2. local climate

3. local geography
4. survey methods
5. collection methods

Bison behavior: There is little about the social behavior of bison that is unique. Adult cows and sub-adult bison are highly gregarious. Bulls are found in small isolated groups for most of the year. Rut occurs in August to September.

The distribution of bison in Alberta is at least partially known. This information has been obtained from the extensive network of trappers, oilfield workers, forestry and aircraft pilots who work in remote areas at all times of year. Although these people provide casual observations, their collective efforts is very effective.

This effort would be supplemented with aerial surveys and radio telemetry. Seasonal movements are not known but winter locations (some of which are known) of bison are what we are most concerned about.

Local climate: Seasonal conditions limit the dates when it is possible to work effectively in the area. Surface moisture prevents access during ice-free periods. Mosquitoes and other biting insects also make work during this period extremely difficult. Leaf cover in summer reduces the feasibility of aerial surveys. The majority of work must be done after

freeze-up and before break-up. Limitations during the winter period are severe cold weather and short day lengths. The period from February 15 to March 31 is the most productive period both from the point of view of temperatures and day length.

Geography: Topographic relief in most parts of the area is minimal. The exception is the Caribou Mountains, a high plateau west of the Park. The southern escarpment of the plateau is a predominant feature incised by the Ponton and Wentzel Rivers. The banks of the Peace River west of Wood Buffalo National Park are relatively shallow. To the south the Wabasca and the Mikkwa River flow into the Peace across the flat muskeg area. They do have moderately high banks in some areas. Most areas south of the Peace are sparcely forested. To the north of the Peace there are some heavily forested areas with spruce and pine. On the Caribou plateau there is very sparce forest except on the south-facing escarpment. Lakes are abundant on the plateau ranging in size. Margaret Lake and Wentzel Lake are the 2 largest.

Survey methods: We will fly fixed wing transects in winter to locate bison site in snow and to count animals. Because sign is dispersed over a large area, transects located at 6 mile intervals will identify all locations where bison have been present. Two passes per winter over a 6 to 7 year period will locate all bison. One system of locating animals in a low

density involves the use of radio transmitters. With a sample of bison marked with transmitters in different locations, unmarked bison associated with marked ones can quickly be discovered. In winter months hay could be flown to remote locations where sign has been observed in the snow to bait bison to open areas and to habituate them to supplemental feeding so they have may be easily collected.

Collection methods: In the areas outside Wood Buffalo National Park in Alberta bison do not exist in large concentrations but rather small dispersed groups. We will not have the luxury of large handling facilities that we can bait bison into. We will bait bison with air lifted hay and to tame them so that we can collect them more easily from the ground. We will not be able to avoid the need to shoot some of the animals from the air. It will be necessary to use every opportunity to shoot lone bulls in outlying areas. Aerial shooting of bison has been extremely effective for recent disease collections. We have not lost a single animal that we have shot at.

4.1.3 The cost of these measures outside WBNP have not been assessed in depth; however, we can provide some evaluation of potential cost.

50 hours fixed-wing @ $200	$ 80,000
200 hours helicopter surveillance/year (8 years) @ $500	800,000
20 man-weeks/year @ $700 (8 years)	112,000
20 weeks/year travel @ $400 (8 years)	64,000
20 weeks vehicle costs @ $400 (8 years)	64,000
Hay $1,000/year (5 years)	5,000
Radio transmitters 15 @ $600	9,000
Capture drugs	50,000
Miscellaneous costs	20,000
TOTAL	$1,204,000

4.2 Disease containment

4.2.1 If the containment option were selected, Alberta Fish and Wildlife would not be a participant. It would not contribute to the establishment of wood bison populations in Alberta outside Wood Buffalo National Park. Simply there would no longer be any concern related to our mandate to manage or enhance wood bison in the area.

4.3 Disease elimination

4.3.1 Feasibility and cost considerations

4.3.1.1 We see no value in maintaining a disease free hybrid bison population in Wood Buffalo National Park or

elsewhere. Under this regime Alberta would still refrain from introducing wood bison into northern Alberta.

4.3.1.2 It is possible to salvage bison from Wood Buffalo National Park and Slave River Lowlands but we feel this may not be necessary. Many ungulate populations have experienced narrow genetic windows. We have thriving wood bison populations in the McKenzie Bison Sanctuary and Elk Island National Park with no indication of insufficient genetic diversity. In fact the diversity will be strengthened by mixing the McKenzie Bison Sanctuary and Elk Island bison together. Salvage of bison will add expense, delay and complexity to a situation that already has plenty of each.

4.3.1.3 The Alberta component of the replacement option would be completed as described in sections above. Depopulation would be completed as soon as possible. If no new herds are discovered, 95% of depopulation may be completed in the first year. Surveillance will continue for eight years or until four consecutive years of surveillance have been completed without sign of bison in areas outside WBNP (which ever occurs last).

Repopulation in Alberta will consist of re-instating objectives at Hay-Zama Lakes west of High Level. Plans for bison east of High Level will only be developed after bison are established at Hay-Zama Lakes. Dispersal of bison from re-introduction in WBNP and at the MacKenzie Sanctuary may populate those areas without our effort. Our objective is to establish huntable bison herds for recreation, subsistence and commercial guiding and this is clearly defined in our agreement with the Dene Tha band.

4.3.1.4 Salvage of bison meat and by-products in areas outside WBNP would be more difficult than within the park boundary. Small numbers of bison and their dispersal over vast areas make salvage difficult and time-consuming. Salvage will be done when possible but it will not be possible to deliver livestock to the proposed federal abattoir in Fort Smith. Field inspection may be feasible for some carcasses to be delivered to native people and others in need of subsistence but many will have to be used for non-human consumption or even left on the ground for scavengers.

The sale of wood bison products, including meat, is not permitted Alberta; however, the sale of hybrid

bison products is not restricted by the Wildlife Act.

4.3.1.5 On the matter of repopulation of WBNP a detailed plan must be prepared that will achieve repopulation at the earliest date after total depopulation criteria have been achieved. No bison should be released from holding compounds until depopulation criteria have been met in all areas. Those criteria are as stated in earlier sections to complete four consecutive years of surveillance without sign of bison in all depopulation zones.

4.3.2 Ecological Considerations

4.3.2.1 John Gunson, our wolf specialist, provided the following summation of what he felt would happen to the wolf population in Wood Buffalo National Park if the bison were removed.

This is in response to your request for an evaluation of wolf dynamics related to possible population reduction of wood bison in Wood Buffalo National Park (WBNP). Because of time limitation, I did not conduct a thorough search of the wolf/bison literature.

Wolves of WBNP depend heavily on bison. Oosenbrug and Carbyn (1985) reported 40 of 42 kills located during three winters were bison (kill rate = 1 kill/6.8 days). Bison were also the most important component of the diet of wolves as indicated by scat analyses during 1977-80. Bison comprised 82% of the biomass consumed during winter and 57-67% during summer. Including moose, the only other ungulate consumed by wolves, total ungulate relative biomass was 98% in winter and 68-80% in summer (Oosenbrug and Carbyn 1985).

Removal of all or most of the hybrid bison [Option #2 (BDTF 1989)] would undoubtedly have a profound effect on WBNP wolves. Effective removal over the 3 - 5 years would lead to fewer wolves. The mechanisms of this decline would probably include malnutrition, territorial transgression, inter-pack hostility and fighting with related mortality. This scenario was observed on Isle Royale, Michigan during 1980-82, when wolves declined from 50 to 14 in 2 years, a result of food stress related to a long-term decline in moose abundance (Peterson and Page 1988).

Dispersal of bison wolves from WBNP following loss of their major prey would probably pose no significant hazards. The WBNP wolves are highly specialized at

preying on bison, especially during winter, and would probably not adapt readily to different prey elsewhere. They would have to compensate with resident wolves which would actively defend their real estate.

Resulting decline of the WBNP wolf population would not be critical or long-lasting. As the successful growth of disease-free population of wood bison in WBNP would set the stage for natural recolonization by wolves from adjacent areas. Wolves have high reproductive capability and will repopulate control areas rapidly (e.g., Elliott 1987).

In summary, effective replacement of diseased hybrid bison in WBNP by option 2 would result in extensive wolf population reduction, but this would have little long-term consequence to wolves in northern Alberta and adjacent areas.

4.3.2.2 The potential environmental impact of bison depopulation is secondary to the present impact of hydrological manipulation associated with the Bennett Dam in British Columbia. Any proposal to manage range in the delta area must come to terms with that issue first. Controlled burning may be used as a tool to

impede the succession of woody vegetation in the delta resulting from flood control.

4.3.2.3 (Agriculture Canada to respond.)

4.3.2.4 We expect the impact on other wildlife of replacement activities outside of Wood Buffalo National Park to be minimal since most activities will be in the winter when migratory birds are absent. There will certainly be some impact on scavanging birds such as jays, ravens and chickadees, etc. They will initially have a surplus of carrion that will exceed their ability to consume. Then they will experience a deficit while bison populations are being replaced. Impact on scavanging species is certainly reverseable as bison are replaced.

4.3.3 Social economics

4.3.3.1 In our experience native hunting of bison is primary by the people of the Little Red River band and the people at Fort Chipewyan. However, in recent years some Metis and even some white hunters have been taking a few bison. Native hunting of bison is an opportunistic activity that occurs when bison are readily accessible. West of Wood Buffalo National Park we are not aware of any bison being shot since

the winter of 1986-87. During that winter the bison were located along the road on the south side of the Peace River and were readily accessible. In the previous winter (1985-86) there was good access between the Wabasca and the Mikkwa Rivers due to seismic activity and many bison were shot that year. Alberta does not regulate the hunting of hybrid bison and native hunters will have to compete with unregulated white hunters and even outfitters for bison. It has only been in recent years that white hunters have recognized the opportunity that exists for bison and the fact that it is unregulated.

4.3.3.2 If the replacement option is implemented there will be many temporary and term positions for local people. In the long, term community benefits will relate to bison ranching and improved tourism.

4.3.3.3 During the replacement phase bison will not be available to hunt. Fresh bison carcasses will be made available to effected individuals and communities during this phase.

4.3.3.5 There is no tourism in areas outside WBNP related to bison at this time. No negative economic impact is anticipated to result from temporary depopulation.

4.3.4 Regulatory considerations

4.3.4.1 Alberta's wildlife act and accompanying regulations would govern the hunting of wood bison in Alberta.

Alberta's bison objectives are to establish free roaming wood bison (which includes huntable populations) across the north that will benefit recreational hunters, guides and native peoples. Successful implementation of option 2 is the only option that would allow achievement of these objectives.

4.3.4.2 No regulatory restrictions identified at this time.

4.3.4.3 (to be handled by Parks Canada)

4.3.4.4 (to be handled by Parks Canada)

4.3.5 Other considerations

4.3.5.1 (to be handled by Parks Canada)

4.3.5.2 The replacement of disease hybrid bison with wood bison would very quickly lead to the complete delisting of wood bison by COSEWIC and possibly by CITES. Alberta's regulations would also be amended to classify wood bison as big game.

4.3.5.3 (to be handled by Agriculture Canada)

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Northwest Territories Economic Development and Tourism

12 October, 1989

Mr. Colin Lachance
Wood Buffalo Assessment Panel
Federal Environmental Assessment Review Office
510--750 Cambie Street
Vancouver, British Columbia
V6B 2P2

Dear Mr. Lachance:

My apologies for the delay in forwarding a response to your questionnaire. I hope this suffices. Due to the time constraints, I have tried to address each item as concisely as possible. I would be happy, however, to reiterate if needed.

One point I wish to stress is the prospect of The Department of Economic Development and Hanging Ice Ranch Ltd.(Fort smith Hunters and Trappers) establishing a small pilot project for the purposes of raising Wood Bison. Should this become a reality, the infrastructure would be in place for an initial restocking program.

O.E. Machey, P.Ag.
Agriculture and Renewable
Resource Development

CURRENT STATUS

1) If current status is maintained in terms of the present Wood Buffalo remaining intact, It is not the mandate to enact any specific measures to eliminate risk associated with it's presence. As you may well be aware, the Government of the Northwest Territories(GNWT) is presently considering becoming actively involved in the establishment of a Commercial Wood Bison farming operation in the Fort Smith area. The existence of contagious diseases with the wild herd and the ability of the proposed operation to nullify the potential for transmission and infection is a much discussed subject. Such measures as: a buffer zone on the perimeter of the proposed operation, reduced scale of the project to allow for an intensive management regime and a vaccination program are planned to reduce risk of disease transmission.

All indications are, however, that the project will proceed at least, on a pilot project basis. In the event of an outbreak, the GNWT will be responsible for absorbing costs associated with the project.

Disease Transmission: In terms of risk of disease transmission to existing domestic livestock in the vicinity of Wood Buffalo Park. There is presently one cattle operation in the Fort Smith area comprised of approximately 24 head. This operation has been in existence for a number of years and has to date experienced no problems relating to the presence of the infected wild bison herd.

Present Impact The presence of the diseased herd in the Fort Smith area does not exert as much influence on decisions made pertaining to developments in the area as might be expected. The tourism industry is expanding with the primary draw being Wood Buffalo National Park. As mentioned, there are plans being put in place for establishment of a Bison game farm in the area. It may well be that the absence of confirmed outbreaks of disease to other populations in the area, be they wildlife or human, has created a sense of security as to the potential for transmission..

Interim Risk Reduction In the event that a disease eradication program were implemented, The Department of Economic Development and Tourism would, in all probability, not have significant input into a risk reduction program. This would primarily be the mandate of the Department of Renewable Resources. We would take into account program criteria when determining government participation in livestock ventures in the area

5) Feasibility and Cost Considerations: The feasibility of isolating and maintaining a captive disease-free Wood bison herd has been examined by our Department in detail relating to the establishment of such a herd in the Fort Smith area. Projections indicate that an initial herd of 100 breeding animal would take seven to ten years to achieve economic viability assuming government participation in terms of capital and operational inputs. Naturally, if economies of scale were examined and the initial herd size was increased, the recovery time would be reduced.

The proximity of the diseased herd to the proposed operation has caused us to reevaluate the concept of a commercial herd from the onset. It is for this reason that we are examining the establishment of a small pilot project of some 40 animals. It is hoped that we can evaluate the biological, managerial, and physical parameters involved in maintaining a disease free herd prior to establishing a commercial operation.

I feel it is worth noting that the presence of a confined herd in the area would eliminate much of the speculation and theorizing as to the establishment of such a herd. It may well be in the interest of all parties involved to have a more active participation in the formulation of plans for establishment of such a herd. We would very much appreciate input.

As to the question of salvaged animals from a disease eradication program being used for re-establishment, The MacKenzie Bison Herd in the Fort Providence area could be used as a case in point as to the viability of such a program. This herd was established using selected animals which were identified and tested from animals in Wood Buffalo National Park. To date, there is no evidence of disease in this herd. Obviously, there is a certain degree of risk associated with this kind of restocking program, however, if such a program allowed for establishment of a number of smaller herds which could be monitored regularly, the probability of a subsequent outbreak could be greatly reduced.

Barring the utilization of salvaged animals in a restocking program, I would think that the period for re-establishment of large, free-roaming herd would be greatly extended.

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Northwest Territories Health

September 19, 1989

File # 281-1-1

Colin D. Lachance
Executive Secretary
Northern Diseased Bison Environmental
Assessment Board
Federal Environmental Assessment Review Office
510 Cambie Street
Vancouver, B.C.
V6B 2P2

Dear Mr. Lachance:

Re: Information Requirements - Diseased Bison

In response to your letter of July 11, 1989, please find enclosed, our response to the Information Requirements issued by the Northern Diseased Bison Environmental Assessment Panel.

I trust you will find this information to be satisfactory. If I can be of further assistance, please do not hesitate to contact me.

Yours truly,

J.A.MacKinnon C.P.H.I.C
Head, Environmental Health

encl.

3.1 Disease Transmission

The transmission of diseases from animals to humans is a major concern of the Department of Health. The Department is presently in the process of developing and distributing information brochures on zoonotic diseases. A brochure on trichinosis has been distributed and one on brucellosis is in the development stages, with others being contemplated.

This public education policy will be continued across the Territories in order to reduce the potential risks to the population.

3.2 Program Assessment

Assessing the effectiveness of any proactive educational program can prove very difficult. It is therefore especially important to take all possible preventative measures where a potential risk has been identified.

3.4.1 Costs

It is difficult to assess the costs of a specific disease to the Health Care System or an infected person. The length and severity of symptoms can vary significantly as can the type of treatment required.

4.1.1 Interim Protection Measures

The Department of Health does not plan any interim protection measures designed specifically for application in this situation. Risk reduction measures in the form of public information and education brochures on zoonotic diseases are being prepared and distributed throughout the Territories.

4.2 Disease Containment

Containment of the diseased animals would not change the thrust of the Department of Health's disease prevention programs. However, containment would, by reducing public access, reduce the potential risk to the public.

Commentai

There have been three cases of Human Brucellosis reported in the lower MacKenzie region of the Northwest Territories between 1980 and 1987. This compares with 38 cases reported from throughout the Territories during the same period.Only one case of bovine tuberculosis has been reported since 1979.

Although the incidence of Mycobacterium bovis infection (bovine Tuberculosis) is low, there have been documented cases of infection being transmitted through aerosolization associated with butchering of meat.

Should the destruction of the animals occur, measures must be taken to protect all persons involved and all meat that is released for human consumption must be inspected and determined to be disease free.

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OCT - 2 1989

FEARO PACIFIC

Government Leader

SEP 22 1989

R. G. Connelly,
Chairman,
Northern Diseased Bison Environmental
Assessment Panel,
Federal Environmental Assessment Review
Office,
510 - 750 Cambie Street,
Vancouver, B.C.
V6B 2P2.

Dear Mr. Connelly:

Information Requirements - Northern Diseased
Bison Environmental Assessment Panel

Please find enclosed our response to your Panel's request for additional information. I look forward to hearing more details of the timetable for the confirmation of the review process.

Yours sincerely,

Dennis Patterson

Dennis Patterson,
Government Leader.

Enclosure.

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Response to Requests for Additional Information from the Northern Diseased Bison Environmental Assessment Panel

Department of Renewable Resources
Government of the Northwest Territories
Yellowknife, N.W.T.

September 1989

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INTRODUCTION

This response of the Department of Renewable Resources to the Northern Diseased Bison Environmental Assessment Panel's request for additional information is presented in five sections: actions possible should the current status be maintained; interim protection measures; actions associated with containment; actions associated with the replacement option; and replies to three questions identified for the department listed in appendix I of the panel's request. It must be emphasized that all responses should be viewed as summarizing the possible role of the Department of Renewable Resources under these various scenarios. Proceeding with any particular option would, among other things, be contingent upon the findings of the panel, further discussions within GNWT and discussions between GNWT, other government agencies and the Denendeh Conservation Board. Financial costings are included for various actions, although funding sources are not identified.

The responses concern actions that may be taken by the GNWT through its mandate under the NWT Wildlife Act. Emphasis is therefore on activities within areas outside of Wood Buffalo National Park (WBNP) within the NWT. Obviously close coordination would be necessary with agencies whose mandates include WBNP and adjacent areas in Alberta. To this end the Department has already responded to requests from other agencies for information they required to develop their responses.

The responses given are consistent with the goals and objectives of the Department of Renewable Resources, specifically the following:

-to maintain viable populations of wildlife in their natural habitats;

-to ensure sustainable use of natural resources.

RESPONSES

Numbered sections given below are as used in the panel's request document.

3.0 Current Status

3.1 Additional Activities Possible by the Department of Renewable Resources Should the Current Status be Maintained

a) Expansion of the buffer zone and intensification of surveillance within it, would be one way to try to reduce the risk of both disease and genetic contamination of wood bison in the Mackenzie Bison Sanctuary (MBS). More details are given in our response to "Appendix 1" questions on p. 13. It

is impossible to evaluate the efficiency of this increased effort, except to say that it will reduce the risk of contamination, but it will not eliminate it. The goal would be to stop expansion of MBS animals southward and Nahanni wood bison eastward. A necessary adjunct to this program would be that no bison be reintroduced into southern NWT outside of WBNP. Annual costs excluding manpower are estimated at $115,000.

b) Annual testing of a sample of animals from the MBS would be required. Emphasis could be on males at the southern edge of their range, although recent results show that there is much movement by males from the periphery back to core areas. For example, during spring 1989 one radio collared male moved 120 km from Mills Lake to Falaise Lake. This work will not reduce the risk of contamination, but positive test results will affect many activities associated with the management of wood bison (see section 3.4.1). The majority of animals would be captured, tested and released. In addition some animals killed by hunters would be tested for tuberculosis. Costing is as follows:

40 bison (capture/testing).....$16,000
(excluding manpower per year)

c) Safeguarding bison within the planned bison ranch boundary near Fort Smith would be the responsibility of the ranch directors and manager. However, in order to alert the manager to the close presence of bison near the ranch, regular aerial monitoring could be undertaken. By alerting the manager, extra checks of the fence could be made, which may reduce the risk of contact. Costing is as follows:

Monthly flights, (plus an additional one during the rut)
13 x 4 h x $300.....$15,600

d) The Department of Renewable Resources would attempt to increase the size of the infected bison herds in the Slave River Lowlands. This action would be in response to strong local interest in the recovery of bison for consumptive use. Disease, predation and hunting have all been implicated as significant mortality factors limiting the productivity of these animals. A main

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initial component of this effort would be a research program trying to quantify the relative effects of these factors. Abundance, age structure, mortality factors and disease prevalence/intensity would be investigated and results compared to past work in the area as a prelude to producing a management plan. Annual costing is as follows:

SRL research program.....$40,000

e) Conservation education initiatives should be started by the Department in a number of areas. The first would be to alert people to the importance of reporting bison in the buffer zone. This would add to the effectiveness of this zone. The second would be to ensure members of communities hunting potentially diseased animals use safe handling and cooking techniques and can recognize obviously infected individuals once shot. Development of this educational material would be done after consultation with the GNWT Department of Health. This program will help reduce the risk of infection to hunters and their families. Implementation would proceed directly with the public, but would also involve Hunters' and Trappers' Committees and the Denendeh Conservation Board. Costing would include posters, videos and television time and would be as follows:

All conservation education
(year 1).....$30,000
Subsequent years.....$10,000

Total annual costs for activities listed under section 3.1 are estimated to be $227,000, excluding manpower, if the current status is maintained.

In addition to existing manpower, approximately 1.7 person years (PY) would be required to conduct identified projects.

3.4.1. Costs of Disease Transmission (i.e. Failure of Above Measures)

a) Disease transmission to wood bison in the Mackenzie Bison Sanctuary would negatively threaten the recovery program for this subspecies in the N.W.T. and Canada. Disease would be expected to lower the productivity of the population and thereby lessen the availability of

animals for utilization. In addition, given that the Mackenzie population represents 2/3 of the world's wood bison, infection with the diseases would seriously reduce the rate of recovery of this endangered subspecies. Meat wastage because of infection, plus sanctions against the export of meat and fresh trophies, would all lead to reduced economic potential for wood bison. The presence of disease would hinder the use of MBS animals as stock for future reintroduction both within and outside of the NWT. Specifically, it would not be possible to contribute breeding stock from the Mackenzie Bison Sanctuary to other Canadian projects involved with maintaining diversity in the genetic management of wood bison. Costs to affected parties are difficult to assess, but government, hunters and the wood bison themselves would all be negatively affected.

b) Failure to stop infection of bison in the proposed ranch near Fort Smith, would result in the necessary depopulation and restocking of the facility as required by Agriculture Canada's regulations. Costs incurred would depend on the number of head that need to be replaced; this would be larger the longer the facility has been in operation. Also, the risk of contamination would be expected to rise as the wild SRL population expands in response to management. The financial loss to the ranch would likely threaten its viability. Minimum costs for replacement of stock would be $2,000 per head.

c) Disease transmission to people would negatively affect this Department's objective to develop the renewable resource economy. By association there could be disruption of all types of use of wild meat, not only from bison, especially any being exported outside the NWT.

3.4.2. <u>Costs of Genetic Contamination</u>

Genetic contamination of wood bison in the MBS would likely accompany disease transmission, but it is useful to consider the negative effects separately. Genetic contamination would represent a serious setback for the recovery of wood bison. Should the degree of contamination be such that it is predicted that over time the population as a whole could not be considered wood bison, then two alternatives exist. The first would be to deem the MBS system unsalvagable, which would likely be the effective end

of conserving wood bison in the wild. All past funding associated with this program would therefore have been wasted, an amount not less than $1,000,000 from GNWT sources. Of more importance would be the irrevocable loss of yet more genetic diversity from the world. The conservation of genetic diversity is an important principle embodied in the World Conservation Strategy and endorsed by the GNWT within its proposed Sustainable Development policy.

The second alternative would be to depopulate the MBS and start the recovery program yet again, using captive stock. This would be an unlikely course of action unless management of hybrid animals outside the MBS changed to significantly lessen the threat of genetic contamination. Financial costs to the GNWT would exceed the estimated $1,000,000 expended on the Mackenzie Bison Project to date.

Genetic contamination, in the absence of disease transmission, would not hinder the development of use of the MBS population for meat, but it would negatively affect trophy market potential.

3.5. Disease, Tourism & Game Ranching

One of the management objectives of this Department for wood bison is to increase non-consumptive (tourism) use. Through limitation of productivity, disease would reduce the opportunities for viewing. It is also possible that publication of details of the disease situation, plus the knowledge that the diseases can cause pain and suffering to infected animals, would have a negative effect on tourist development.

The possible effects of disease on bison game ranching have been discussed above. The presence of disease would be a threat to other ranching proposals, should these develop in the future, including livestock development. The possible role of global warming in increasing the possibilities for ranching of other species in the southern NWT in the future, should be considered.

4.1 Interim Protection Measures

Interim protection measures would be the same as those additional activities listed under 3.1 above.

4.2 Disease Containment

This Department's response to the containment option would vary whether a fence, buffer zone or both were employed. If a buffer zone was agreed upon, then presumably those activities referred to under 4.1 above would be carried out. If fencing proved effective, surveillance in a buffer zone could be reduced. However, some lower level of monitoring would be required to manage risk. Conservation education initiatives to do with the buffer zone would also be scaled down. It must be remembered that the presence of diseased animals would always pose a threat of contamination for the MBS herd.

Should diseased hybrid bison be contained in the Slave River Lowlands, then, as described above, a program to increase the size of this population would be started. If successful, this could necessitate additional aerial monitoring near the proposed bison ranch.

4.3 Disease Elimination

The following section on disease elimination only refers to those areas falling under the jurisdiction of the GNWT. Obviously a disease elimination/replacement option would require close coordination between a number of agencies. To this end the Department of Renewable Resources, and several other agencies have responded to Agriculture Canada's request for information to assist them in preparing a detailed plan for replacement. It is our understanding that this document will be provided to the panel in response to their information request.

4.3.1 Feasibility and Cost Considerations

a) Although it may be feasible, the Department of Renewable Resources would not wish to become involved in isolating and maintaining disease - free hybrid animals in the Slave River Lowlands. Such a move would likely not be in agreement with our objective of seeing healthy wood bison reestablished within their former range. At the present time any disease-free salvaged hybrids from the SRL would only be considered for donation to other agencies that may want them. Preservation of hybrids in the SRL would limit the areas available for re-introduction of wood bison and therefore negatively affect the scope of the recovery program.

b) Salvaging wood bison from the SRL would be supported by the Department of Renewable Resources. This would only be done if a whole population was

classified as wood bison, based on phenotypic scoring and cranial measurements. It is believed that an adequate sample of 20 male skulls can be obtained from communities hunting bison in the SRL, east of the Slave River. Criteria for deciding on taxonomic status need to be established before the procedure starts. Standards and methods for salvaging disease-free wood bison would be set by Agriculture Canada. It is envisaged that these will include the following components and would compliment salvaging wood bison from WBNP should that be undertaken. Given the low density, individual darting from a helicopter would be the method of choice. Immobilized animals would be tested by rapid card test for brucellosis. If found negative, animals will be transported by helicopter sling to a holding facility. Testing for tuberculosis and further tests for brucellosis would be performed as required by Agriculture Canada. Bison will be held within double fenced enclosures and allowed to breed. If generation 2 stock remain tuberculosis and brucellosis free after their first calving season they and their offspring may be released to facilities in WBNP for breeding stock. A standard period of time would then need to be set, during which no bison were observed in the wild, before repopulation could start using captive breeding herds. This would likely be 3 to 4 years. Costing would be as follows:

	Approx. Annual Cost ($)
Genetic testing SRL - phenotypic scoring plus skull measurements; helicopter use 3 x 8h @ $600/h.....	$14,400
Helicopter for capture (50 bison) 75h x $600/h.....	$45,000
Helicopter for bison transport (40 bison) 40h x $1200.....	$48,000
Drugs @ $300/hd x 50hd.....	$15,000

Refer to Agriculture Canada's response for costing of holding facilities.

c) Removal of the approximately 400 diseased and/or hybrid bison from the Slave River Lowlands, as a prelude to reintroduction of wood bison, could initially involve local communities. Given the low abundance of animals, it is possible that financial support would be necessary to assist local people to hunt as many animals as they can find. Helicopter support would be necessary to get carcasses to mobile

abattoirs. Aerial surveys would be used to help locate bison. Once again, standards for declaring a disease-free status would be taken from Agriculture Canada. Costing would be as follows:

	Approx. annual cost ($)
Hunter support (3 yr period)	$30,000
Helicopter time (@ $1,200 per hour)	$50,000
Fixed-wing time (@ $300 per hour)	$10,000
TOTAL	$90,000

It is suggested that after a three year period of assisting local hunters to remove animals, individual shooting from a helicopter be used to remove the remaining animals. Experience from within WBNP in dealing with animals in low density areas could also affect the method used. Costing would be for an additional 7 year period, and only helicopter time plus fixed-wing survey time is considered. It is hoped that this 7 year planning would allow sufficient surveillance time (3 to 4 years) during which no animals were found, to declare depopulation of the SRL complete and allow repopulation to commence.

	Approx. annual cost ($)
Helicopter time (@ $600/h x 60h)	$36,000
Fixed-wing time (@ $300/h x 100h)	$30,000
TOTAL	$66,000

Given the time commitment for this work, the Department of Renewable Resources would expect to recruit additional staff to carry it out. This is estimated at 1 PY for 10 years.

d) The GNWT's role in repopulation would be to be prepared to supply animals from the MBS on an annual basis over a five year period. This option would be dependent on the success of the genetic salvage operation. Wood bison would be held in enclosures in both the SRL and WBNP. Major costs for rounding up bison in the MBS involve the construction of a corral, estimated at $200,000; transport of 100 bison/yr over five years ($5,000/yr). Manpower

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requirements would be 5 men for 2 months per year (0.8 PY).

4.3.2 Ecological Considerations

4.3.2.4 Disturbance Effects

Outside the park, the use of local hunters initially, and the low numbers of bison to be removed, would both mitigate any disturbance problems with other species.

4.3.3 Socio-economic Considerations

a) We do not know how many bison are harvested by General Hunting Licence (GHL) holders in the Slave River Lowlands, but believe the annual crop to be well under 100 animals within the NWT.

Hunters from Fort Resolution take animals from Hook Lake and adjacent areas to the west of the Slave River. Hunters from Fort Smith take animals from the Little Buffalo River area north to Grand Detour.

The report of Wein and Sabry (1989) indicates that at present bison are less important than caribou or moose as meat items for Native families. If the status quo were maintained in terms of bison management then we predict a decline in utilization of bison as availability declines. Under an option of disease eradication we would predict perhaps a 6 - 10 fold increase in use as the SRL population recovers.

b) Under the replacement option, local hunters would form part of the depopulation phase in the SRL. Likewise healthy carcasses would be available for consumption from harvesting in WBNP. However, there would be a period of at least 4 years after depopulation is completed, when both the opportunity to hunt bison and the availability of bison meat are absent. In compensation for the loss of harvesting opportunities it is likely that Agriculture Canada would make bison meat available, so at least consumption patterns are not disrupted.

c) The areas under the jurisdiction of the GNWT would not be negatively affected in terms of tourism, during a depopulation/repopulation program. Indeed it is possible that tourism in the MBS may increase.

4.3.4 Regulatory Considerations

a) The Wildlife Act of the Northwest Territories (NWT) treats hybrid and plains bison separately from wood bison. The Wildlife Regulations specify that general hunting license (GHL) holders can harvest an unlimited number of hybrid and plains bison of any age or sex. Harvesting is permitted throughout the year in wildlife management unit G/3, roughly located along the Slave River. Only GHL's are permitted to harvest hybrid and plains bison within the NWT.

Both GHL holders and residents may hunt wood bison, but only when in possession of a wood bison tag. At present, General Hunting license holders are allotted 28 tags which are distributed by the Dogrib Tribal Council (12 tags) and Fort Providence (16 tags) Hunters' and Trappers' Association. Both GHL holders and resident hunters are eligible to use these tags with the approval of the Hunters' and Trappers' Association. Resident hunters are also allotted 12 tags which are distributed by way of a draw administered by the GNWT. All 40 tags must be used on wood bison within wildlife management zone G/2-1. This management zone is contained within the Mackenzie Bison Sanctuary. Both types of hunters are permitted to hunt from the 1st of December to the 31st of March and are restricted to harvesting bulls only.

Meat from legally killed bison can be given away as a gift by general hunting license holders. Currently there are no provisions in the Wildlife Regulations to allow for the sale of bison meat as there are for muskox, caribou and polar bear. However, it is clear from the Wildlife Act that there is the legal option of doing so.

After any repopulation with wood bison outside of WBNP, regulation changes would be made so as to allow hunting. Quotas would be set based on census data and the recommendations of the Denendeh Conservation Board. This situation would therefore be as is already occurring for wood bison in the MBS.

4.3.5 Other Considerations

a) Once four population of wood bison are established, each over 200 animals, then wood bison would be removed from the threatened list under COSEWIC. The designation of endangered under the NWT act would remain the same to enable quota management for all

users.

b) During repopulation it is expected that Agriculture Canada would organize appropriate sampling within corrals. Samples would be taken from hunter killed animals after repopulation as an ongoing disease surveillance measure.

Information on Activities in Three Areas

(Appendix 1 questions)

1. Genetics and Taxonomy of the Slave River Lowland Population

The Department of Renewable Resources is involved in a number of collaborative projects concerning the taxonomy of wood bison. Ongoing work falls into four areas: phenotypic studies, skeletal measurements, recombinant DNA analyses and blood typing. Phenotypic studies in the Slave River Lowlands planned for winter 1989/90 involve the use of a character index developed by van Zyll de Jong (National Museum of Natural Sciences, Ottawa). The index allows individuals to be placed on an axis representing external phenotypic variation from B. b. bison to B. b. athabascae. Multivariate morphometric analyses of cranial and post-cranial data were used by van Zyll de Jong (1986) to examine the sub-speciation of bison. At the present time material is available from approximately 20 animals in the Slave River Lowlands and 30 animals in the Mackenzie Sanctuary, for comparative analyses.

2. Bison - Wolf Predator Prey Relationships

The main study in this area carried out with northern bison remains that conducted by the Canadian Wildlife Service in Wood Buffalo National Park (Oosenbrug and Carbyn 1985). The Department of Renewable Resources collaborated with the CWS and Agriculture Canada on ecological studies of bison in the Slave River Lowlands, which included a consideration of wolf predation (Van Camp 1987). A main conclusion was that disease, wolf predation and hunting were major factors contributing to the decline of the SRL population. However, the bison population continued to decline after harvesting stopped in 1977 and a wolf control program started, the program ran for 2 years. In the Mackenzie Bison Sanctuary, data on wolf predation are collected on an opportunistic basis as part of the Department's Bison Research Project. Provisional proposals have been made to instigate work on wolf/bison/moose interactions in and around the sanctuary, although no firm project is confirmed at present.

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3. Costs Associated with the Mackenzie Bison Sanctuary Buffer Zone

Details of the rationale for the present buffer zone have been given in a previous submission (May 1989). At the present time activity in the area dedicated to surveillance only comprise aerial monitoring for animals or tracks in late winter. Additional costs arise if animals are sighted or are reported independently from ground observations. During 1989 costs were as follows:

	Approx. Cost/Year
Aerial surveillance	$2,000.00
Helicopter follow-up on one ground report	$2,000.00
TOTAL	$4,000.00

Manpower costs are not included.

The expansion and intensification of activity in a buffer zone is not considered a longterm solution to the problem of preventing disease and genetic contamination of wood bison in the Mackenzie Bison Sanctuary. A recent review of the effectiveness of buffer zones and fencing to contain diseased bison has concluded that these measures are ineffective in Yellowstone National Park (Meagher 1989). However, should disease not be eliminated from animals in and around Wood Buffalo National Park, then the following costing would cover an increased use of the buffer zone concept. The relationship between surveillance effort and risk reduction is unknown, except that no amount of searching will produce a risk-free situation. The costing below assumes expansion of the zone to include the area between the western boundary of WBNP and the Trout Lake winter road. Sub-zones would be established to allow variable intensity coverage dependent on the likelihood of encountering bison. Seventy hours of aerial searching would be conducted between November and March. Searching during the snow-free season is not considered worthwhile given observational difficulties. In addition, the Department carries out many fire surveillance flights in the area in summer, where searching for bison could also be included.

	Approx. Cost/Year
Aerial surveillance (70 h @ $300/mo x 5)	$105,000.00
Aerial & ground follow-up of sightings (assume 5 per year)	$10,000.00
TOTAL	$115,000.00

Manpower costs not included.

An update on the previous submission is that during May 1989 three bison were reported by a tourist in the buffer zone, between Fort Providence and Enterprise. The two-day follow-up failed to locate any animals. Observation in wooded country during summer is very difficult.

REFERENCES

Only those not included in the Bison Disease Task Force Report are given:

Meagher, M. 1989. Evaluation of boundary control for bison of Yellowstone National Park. Wildl. Soc. Bull. 17:15-19.

Wein, E. E. and Sabry, J.H. 1989. Nutrient intakes and use of country foods by Native Canadians near Wood Buffalo National Park. Report to Band Councils and Local Agencies: 51pp.

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VEGETATION DYNAMICS OF BISON RANGE IN AND NEAR WOOD BUFFALO NATIONAL PARK, ALBERTA AND NORTHWEST TERRITORIES, CANADA

CONTRACTOR'S REPORT FOR
DSS FILE XSB89-00083-(003)

on behalf of

Federal Environmental Assessment Review Office,
Environment Canada,
Vancouver, B.C.

by

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SUMMARY

This report focusses on the vegetational consequences of Agriculture Canada's proposed course of action to replace disease-exposed bison in northern Canada with disease-free wood bison. The proposed program would involve the removal of several thousand disease-exposed bison from Wood Buffalo National Park and surrounding area. Prior to their slaughter, the removed animals would be held in two 100 square km compounds within the park. The compounds would then be used to hold disease-free bison replacement stock, which would be moved to the compounds from two breeding corrals (10 square km each) on the Slave River Lowland outside the park and from Elk Island National Park and the Mackenzie Bison Sanctuary. After four successive years of aerial reconnaissance without sign of residual bison, disease-free animals would be released into the wild in Wood Buffalo National Park. Even if the proposed depopulation and subsequent repopulation with disease-free animals were to be carried out as quickly as possible, the period of altered bison grazing patterns could involve 10 to 15 years. It is conceivable that some parts of the park now frequented by bison could be without bison for several decades. This study was undertaken to examine some of the possible effects on bison habitat if the bison population and its grazing patterns were to be substantially altered for at lease one and perhaps several decades.

The broad question addressed in this report is as follows: In what ways could Agriculture Canada's proposed program for resolution of the diseased bison problem result in vegetation changes in Wood Buffalo National Park? A general answer to this question is that vegetation changes may result from any of at least five processes: (i) reduced grazing pressure in areas where bison are temporarily removed; (ii) increased grazing pressure inside holding areas; (iii) introduction of non-native plant species in hay if it is necessary to bring bison feed from outside the park; (iv) opportunities for the spread of introduced plant species in newly created disturbances such as along the edges of the proposed 24 km of new road and on cultivated fireguards if the latter were chosen as the way to protect fences around bison holding areas; and (v) if moose populations increase during the period of temporary bison depopulation, woody species that naturally invade meadow areas may be held in check to some extent by heavier browsing by moose than at present.

Specific vegetational data from the Wood Buffalo National Park region are lacking for many of the questions posed in this report. However, available information and experience from elsewhere did not reveal any vegetational or habitat reasons for delaying or altering the course of action proposed by Agriculture Canada.

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VEGETATION DYNAMICS OF BISON RANGE IN AND NEAR WOOD BUFFALO NATIONAL PARK, ALBERTA AND NORTHWEST TERRITORIES, CANADA

This report focusses on the vegetational consequences of Agriculture Canada's proposed course of action to replace disease-exposed bison in northern Canada with disease-free wood bison. The proposed program would involve the removal of several thousand disease-exposed bison from Wood Buffalo National Park and surrounding area. Prior to their slaughter, the removed animals would be held in two 100 square km compounds within the park. The compounds would then be used to hold disease-free bison replacement stock, which would be moved to the compounds from two breeding corrals (10 square km each) on the Slave River Lowland outside the park and from Elk Island National Park and the Mackenzie Bison Sanctuary. After four successive years of aerial reconnaissance without sign of residual bison, disease-free animals would be released into the wild in Wood Buffalo National Park. Even if the proposed depopulation and subsequent repopulation with disease-free animals were to be carried out as quickly as possible, the period of altered bison grazing patterns could involve 10 to 15 years. It is conceivable that some parts of the park now frequented by bison could be without bison for several decades. This study was undertaken to examine some of the possible effects on bison habitat if the bison population and its grazing patterns were to be substantially altered for at least one and perhaps several decades.

The April and May 1989 scoping sessions held by the panel resulted in considerable debate about the possible reasons for the recorded decline in bison populations in Wood Buffalo National Park and the Slave River Lowlands. Factors mentioned included impacts of diseases on reproduction and mortality, predation by wolves, hunting pressure, and habitat alterations due to climatic change and man-induced water level changes. This report focusses on the last of these concerns, namely habitat changes.

In July 1989 the Northern Diseased Bison Environmental Assessment Panel issued contracts to several technical specialists to assemble information on specific questions. This report addresses the following terms of reference specified by the panel:

> "What are the potential ecosystem impacts of bison depopulation/repopulation on the quality and ecological succession of the present grazing habitat? Compare abrupt to gradual depopulation/repopulation processes. Consider the potential for plant succession and changing responses due to lack of flooding. Identify range management options, such as prescribed burning, designed to enhance the habitat for bison use."

The broad question addressed in this report is as follows: In what ways could Agriculture Canada's proposed program for resolution of the diseased bison problem result in vegetation changes in Wood Buffalo National Park? A general answer to this question is that vegetation changes may result from any of at least five processes: (i) reduced grazing pressure in areas where bison are temporarily removed; (ii) increased grazing pressure inside holding areas; (iii) introduction of non-native plant species in hay if it is necessary to bring bison feed from outside the park; (iv) opportunities for the spread of introduced plant species in newly created disturbances such as along the edges of the proposed 24 km of new road and on cultivated fireguards if the latter were chosen as the way to protect fences around bison holding areas; and (v) if moose populations increase during the period of temporary bison depopulation, woody species that naturally invade meadow areas may be held in check to some extent by heavier browsing by moose than at present.

Bison habitat is influenced by other factors besides the presence or absence of grazing. In the Peace-Athabasca Delta, wet meadows, in particular, are strongly under the control of flood regimes. Vegetation changes associated with altered water levels and altered frequencies of flooding need to be understood in relation to bison's preferences for certain vegetation types. Fire is another factor that shapes the vegetation of Wood Buffalo National Park. In the vegetation types used by bison, plant species responses to climatic warming, or to greater year-to-year variation in temperature and/or precipitation, are not well known.

To place these complex relationships in context, Section 1 of this review focusses on a series of questions to assess what we know about bison in relation to their preferred habitats in the absence of altered flood regimes. Section 2 singles out vegetation changes associated with altered flood regimes in the Peace-Athabasca Delta.

Based on the perspectives provided in the first two sections, Section 3 outlines potential vegetational considerations for several alternatives for dealing with the diseased bison population of Wood Buffalo National Park.

The use of several technical terms was unavoidable in this report. To encourage a common understanding of certain terms, some definitions are given here. Production, as used in this report, refers to the dry weight of plant material produced yearly on one square meter or one hectare (10,000 square meters), or one square kilometer (100 hectares). Standing crop (biomass) is the dry weight of plant material present at any given time on a specified area, usually expressed as grams per square meter or kilograms per hectare. Carrying capacity refers to the number of grazing animals, in this case bison, that can be supported by the production of plant material on a continued basis.

For convenience, several frequently used place names are abbreviated as follows: Wood Buffalo National Park (WBNP); Elk Island National Park (EINP); Slave River Lowland (SRL); and MacKenzie Bison Sanctuary (MBS). The Northern Diseased Bison Environmental Assessment Panel, although not abbreviated in this report, is referred to as 'the panel'. Similarly, the Peace-Athabasca Delta is often referred to as 'the delta'.

The subsections below focus on a series of questions that are considered to be relevant to the panel's assignment, either because they have already been raised in scoping sessions held by the panel or because they are of obvious concern to agencies that must implement whatever decisions follow from the panel's recommendations. Each question is followed by a 'short answer' and then a more detailed 'explanation'.

1. Habitat relationships for bison in WBNP in the period before altered flood regimes (pre-1967)

1.1 IN THE VICINITY OF WBNP, WHAT VEGETATION TYPES ARE MOST HEAVILY GRAZED BY BISON?

SHORT ANSWER - Lowland meadows, on delta plains and river floodplains and around marshy lake margins, provide year-round range. Prairie openings in forest are important summer range. Salt plains are mainly winter range, with some summer use.

EXPLANATION - In the SRL, the vegetation is composed of three main types: meadows, shrub land, and forest. On those lowlands the best vegetation types for bison grazing are the wet and dry meadows which cover about 33% of the total area of the lowland (Day 1972). Wet and dry meadows in the Hook Lake area have been described in detail by Reynolds et al. (1978) as follows. Wet meadows are characterized by slough sedge, beaked sedge, and water sedge with some grasses, of which reed grass, white-topped grass and manna grasses are the most common.

Dry meadows are characterized by northern reed grass, baltic rush and less common grasses such as alkali grass, slender wheat grass, foxtail barley, rough bent grasses, and blue grasses. Other sedges present include wind sedge, fernald hay sedge, and slough sedge. In general, however, sedges are a small component of dry meadows which are primarily grasses and forbs. The most common forbs are strawberry, cinquefoil, American vetch, Canada goldenrod, aleppo avens, meadowrue, and western dock (Reynolds et al. 1978, Reynolds 1987).

Within WBNP, lowland meadows, which occur on delta plains, river floodplains and around marshy lake margins, provide year-round bison range. Prairie openings in forest are important summer range, and salt plains are mainly winter range, with some summer use. Dry grasslands that are used by bison in WBNP have plant species typical of grassland vegetation in the Peace River District of Alberta (Raup 1935, Moss 1952). Dominant grasses are

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Stipa curtiseta and **Danthonia californica** (Redmann and Schwarz 1986). These grasses are common on non-saline sites with good surface drainage. In the vicinity of Peace Point and Peace Escarpment there are examples of dry grasslands on sites with a warm micro-climate and with good drainage. In these areas particularly, the grassland communities resemble the **Stipa** grasslands of the Peace River District.

In general, bison prefer to obtain food from areas of wet habitat in the WBNP region. On winter feeding sites, sedges that have been frozen before curing retain a relatively high amount of digestable nutrients and are a succulent source of food for bison (Reynolds et al. 1978). Hudson and Blyth (1986) also noted that the nutritional quality of boreal forage is relatively high and quality during winter is preserved by cold temperatures and snow cover.

Although large meadows are heavily used by bison, smaller meadows around small sloughs or glacial kettle lakes are seldom used (Telfer and Scotter 1975). However, sink holes that are widely scattered in the eastern portion of the Alberta plateau within WBNP do have margins that provide summer forage for bison within forest areas. In general, for summer feeding, WBNP bison appear to prefer forest areas that are interspersed with meadows. In winter, there is a stronger preference for upland meadows, lowland floodplains and delta marshes (Soper 1941).

Observations from other areas indicate that bison are relatively adaptable in the habitat selected for use in any given season. For example, in EINP, where sedge meadows are relatively uncommon, bison strongly selected upland grassland during all seasons with shrub meadows as a second choice. They also spent a considerable amount of time in aspen habitat, perhaps not surprising because aspen is the dominant plant community there (Cairns and Telfer 1980). Bison in EINP showed a preference for use of edges of habitats in all seasons of the year. Van Camp (1975) noted that the heaviest use of sedge meadows in EINP was in February and March (1974) when snow was deep.

1.2 WHAT ARE THE MAIN PLANT SPECIES IN BISON DIETS IN OR NEAR WBNP?

SHORT ANSWER - Slough sedge and reed grasses are the most common range plants consumed in all seasons by bison in this region.

EXPLANATION - Although bison are not as selective as some other grazing species in their choice of forage, two genera stand out in the diet of bison in this area. Slough sedge (**Carex atherodes**) and reed grasses (**Calamagrostis** spp.) are the most common plants consumed in all seasons by bison (Reynolds et al. 1978, Hawley et al. 1981). These two genera provided 92% of the bison diet in spring, 70% in summer, 79% in fall and 77% in winter in the Slave River Lowland.

Less commonly selected forage included beaked sedge (**Carex rostrata**), willows, water sedge (**Carex aquatilis**) and baltic rush

(Juncus balticus). Because of the strong preference that bison have for foraging in wet meadows and because of the predominance of slough sedge in those meadows, management of such meadows is important for optimal production of forage (Reynolds et al. 1978). An important feature of lowland sedges is that they begin growth in spring earlier than grasses. The strong preference for sedges has been noted not only by those who have documented bison diets in the WBNP area but also in a much broader geographic range, as far south as Yellowstone National Park (Meagher 1973).

Fuller (1962) indicated that winter is the most difficult season for bison. It is for this reason that the early spring growth of slough sedge and its dominance in spring bison diet is particularly important. Overall, the nutritive quality of vegetation from all meadow types in the SRL was highest in June (Reynolds and Hawley 1987b).

1.3 ARE THE MOST COMMONLY CONSUMED PLANT SPECIES ALSO THE MOST ABUNDANT SPECIES PRESENT?

SHORT ANSWER - Yes.

EXPLANATION - In the SRL, slough sedge made up 49% of the standing crop in wet meadows and 1% in the dry meadows. Reed grasses made up 18% of the wet meadow standing crop and 64% of that in dry meadows. In wet meadows of the SRL, slough sedge, reed grasses and beaked sedge made up 84% of the total standing crop. By contrast, reed grasses and baltic rush made up 77% of the standing crop in dry meadows (Reynolds and Peden 1987).

1.4 WHAT OTHER VEGETATION TYPES DO BISON USE FOR ACTIVITIES OTHER THAN GRAZING?

SHORT ANSWER - White spruce, jack pine and aspen are used by bison for shelter. Sandy jack pine ridges are also heavily used for dust wallows and serve as migratory routes.

EXPLANATION - Of the four main forest types in WBNP (white spruce, jack pine, aspen and balsam poplar), white spruce provides the most effective shelter for bison during winter storms, although jack pine and aspen forests are also used for shelter. Balsam poplar forests, located along stream banks and delta channels, are used little by bison. Muskeg areas, although very common in WBNP, are avoided by bison (Fuller 1962). From late fall to mid-winter there is some concentration of bison along creek bottoms and gulleys during their search for sedges (Reynolds et al. 1978). An overall summary of bison use of WBNP vegetation types, compiled by Fuller (1962), is reproduced in Attachment 1.

Sandy barren ridges, with jack pine overstory, are heavily used by bison for sand wallows and also provide escape from flies in summer. Soper (1941) recorded a common daily routine when bison moved from open grazing areas to sand, earth or mud wallows located in adjacent forest areas.

1.5 IN WHAT KINDS OF HABITAT DO BISON CAUSE THE MOST CONCENTRATED DISTURBANCES TO VEGETATION?

SHORT ANSWER - Trampling around watering areas and river fording areas, trails leading to watering areas, mud and sand wallows, and groups of trees where concentrated rubbing occurs are the most conspicuous examples of vegetation disturbance as a result of bison activities.

EXPLANATION - Soper (1941) recorded severe disturbance to vegetation as a result of bison trampling around watering areas but such locations are relatively small in area compared to the total habitat used by bison. Other conspicuous disturbances include: rubbing trees which are particularly evident when they are near areas used for watering; salt licks; wallowing areas; fording sites; and heavily used pastures. Jack pine, white spruce, and willow thickets are most heavily used by bison for rubbing. However, aspen bordering meadows in the vicinity of the Sweetgrass corrals were also observed in September 1989 to be strongly influenced by bison rubbing.

One reason that disturbance by bison tends not to be very concentrated is that bison herd size in WBNP is commonly only 20 to 60 animals during most of the year. Groups are larger during post-calving, rutting and late winter seasons when herd sizes may be as much as three times greater than normal. But even the largest concentrations of bison in the post-calving period do not appear to cause conspicuous disturbance to the range resources (Calef and Van Camp 1987). Detailed range studies have indicated that bison in the WBNP area use only a portion of the available forage in sedge meadows. In general, forage is not considered to be a limiting factor for the bison population in the WBNP region (Reynolds et al. 1978).

Some examples of changes to plant communities as a result of bison activities in WBNP were mentioned by Redmann and Schwarz (1986). Disturbance from compaction and erosion resulted in increases in species such as **Carex obtusata**, **Koeleria macrantha** and **Artemisia** spp. Severe disturbance eliminated **Stipa curtiseta** and **Danthonia californica**. These observations indicate that bison may be able to modify dry grasslands in WBNP but a comprehensive range survey would be necessary to confirm this (Redmann and Schwarz 1986).

1.6 HOW SELECTIVE ARE BISON IN THEIR CHOICE OF SPECIES FOR GRAZING?

SHORT ANSWER - Compared to other species of grazers, bison are relatively unselective in their choice of forage.

EXPLANATION - Where grasses and sedges are available these species are selectively grazed by bison, but where sedges or grasses are sparse other food species are readily substituted (Reynolds and Peden 1987). In general, bison are relatively

unselective feeders and can use a diverse range of low nutritive value plants (Peek 1986). Plant consumption by bison in the vicinity of WBNP is not directly proportional to plant availability, suggesting moderate feeding selection (Reynolds et al. 1978). This implies that removal of bison grazing could have an influence on a relatively large number of plant species, not just on reed grasses and slough sedge which are the key species grazed by bison.

Bison have considerable ability to digest low protein, poor quality forage and are better than cattle at using short-grass plants (Jones et al. 1983) and northern range plants (Peden et al. 1974, Richmond et al. 1977, Hawley et al. 1981, Hawley and Reynolds 1987b). In the SRL, during the period of snow cover, especially in late winter, snow hardness is a critical factor influencing food selection. In those conditions bison choose soft snow areas for feeding, and avoid open, wind-swept areas. In this case, selection is occurring not because of the species present but because of the snow conditions (Reynolds and Peden 1987).

1.7 DO BISON OF WOOD BUFFALO NATIONAL PARK CONSUME ANY WOODY SPECIES?

SHORT ANSWER - Willows are the only woody plants specifically recorded to date in the diets of bison in this region.

EXPLANATION - Slough sedge and reed grasses are so prominent in the bison diet in this region, ranging from a low of 70% of bison diet in summer to 92% of their diet in spring, that there is little need for woody species to be browsed. Studies of bison diets in the Slave River Lowland revealed that consumption of willows varied by season, making up 1% of the bison diet in winter, 2% in spring and fall, and up to 8% in summer (Reynolds 1976).

Bison use of forested areas is mainly for shade and for escape from insects, although there is some foraging beneath forested areas during periods of heavy, deep snow. In those circumstances some woody understory species may be consumed by bison (Jones et al. 1983).

Just east of the south end of the corral at Sweetgrass Landing, near an aspen grove that was heavily used by bison for rubbing, all aspen suckers that were encroaching into the grasslands were broken off a few centimeters below the tip when observed in mid-September 1989. One cannot rule out moose browsing of suckers in this area. However, a brief ground reconnaissance in the Sweetgrass area did not reveal a general occurrence of browsed twigs on aspen suckers and other woody species that make up the diet of moose. Browsed twigs were evident only where there had been obvious heavy use by bison as a rubbing area. Without proof that the broken leaders of the aspen suckers near the Sweetgrass corral were actually a result of bison browsing, there are indications that where bison use is sufficiently intense woody species such as aspen can be inhibited

in their advance into grasslands. This is not meant to imply that the leaders of aspen suckers make up any significant part of bison diet.

1.8 WOULD REMOVAL OF BISON GRAZING ENCOURAGE THE INVASION OF WOODY SPECIES INTO DRY MEADOWS OR WET MEADOWS?

SHORT ANSWER - In the vicinity of WBNP, there are no data available on vegetation changes inside fenced areas from which bison grazing has been excluded. It is known that the natural successional trend is for shrubs to gradually invade meadow areas, but the degree to which this trend is arrested by bison grazing has not been defined for the WBNP area.

EXPLANATION - The best way to assess the effects of grazing on plant succession is to exclude grazing by fencing small experimental areas and to record the vegetation changes. Several such exclosures were established by W. A. Fuller on meadows northeast of the escarpment near the mouth of the Salt River. When observed in September 1989, the fence wires of these exclosures were no longer present. Therefore, these former enclosures did not reveal any difference in vegetation inside or outside the previous fence-line. As far as could be determined during this review, no other experimental exclosures were established and maintained within the WBNP area.

In a cleared landing along Sweetgrass Creek, near the Sweetgrass corral, a fenced weather station site did show a greater abundance of shrubs inside the fence than outside, when observed in September 1989. White spruce, willows, red-osier dogwood, wild rose and soopolallie (**Shepherdia canadensis**) were more conspicuous inside the fence than in the surrounding area where bison use was evident. These observations should not be interpreted as evidence that bison had browsed shrubs outside of the exclosure. Browse damage was not now evident and, if browsing had occurred since the weather station was fenced, it could have been attributable to moose. There were a few small, recent bison wallows outside the fenced exclosure. In those isolated wallow areas, woody vegetation, especially white spruce, was severely damaged.

In his description of the SRL, Reynolds (1987) noted that shrub lands and forests are constantly encroaching on meadow communities, creating transition zones of mixed vegetation types. There are also records to indicate that forest encroachment has reduced the extent of grasslands at Peace Point (Jeffrey 1961) from what they were when described in 1928 by Raup (1935). From 1928 to 1959, aspen-closed forest or a semi-open aspen-willow community invaded 75% of the area shown as grassland in the 1928 map. Jeffrey noted that the remaining small prairie openings in 1959 tended to be dominated by shrubs with aspen suckers around their margins. Aerial photographs taken in 1980 and low-altitude aerial reconnaissance in September 1989 indicate that this trend towards forest encroachment into former areas of open prairie is now almost complete.

There are documented circumstances in which ungulates have retarded the invasion of aspen and shrubs into grasslands, particularly in valleys of the Rocky Mountains from Jasper, Alberta, south to Colorado. On the other hand, when Cameron (1975) analysed the grasslands of Prince Albert National Park he found no evidence that ungulates were retarding the natural successional invasion of grasslands by aspen. Aspen regeneration has occurred in that park's bison paddock in spite of the moderately heavy pressure by the display herd.

Moss (1932) thought that bison may have been significant in hindering southward extension of the aspen parkland. In contrast, Roe (1939) regarded bison as "enemies of regeneration" but neither he nor Raup (1933) nor Soper (1941) considered it likely that bison were critical in the prehistoric balance between grassland and forest. Roe was of the opinion that fire was likely more effective than bison in retarding succession of grasslands to aspen. Historical evidence of large-scale destruction of woody vegetation by bison is also lacking (England and DeVos 1969). The latter authors concluded from historical evidence that bison over-grazing in Canadian grasslands was probably significant only in local situations. Where there was local over-grazing and significant amounts of wallowing, these conditions were probably favourable for invasion of forbs and woody vegetation.

Several authors have noted the complementary forage preferences of wild herbivores in boreal forests (Telfer and Scotter 1975, Cairns and Telfer 1980), with moose browsing shrub species and using aquatic vegetation, deer using herbs and also browsing certain shrubs, and bison preferring sedges and grasses. Because other ungulates use rather different species than bison, if large numbers of diseased bison were to be temporarily removed from WBNP, sedges and grasses would be the main species influenced.

1.9 WOULD VEGETATION RESPONSES TO REMOVAL OF BISON GRAZING BE DIFFERENT IF BISON DEPOPULATION WERE RAPID (1 OR 2 YEARS) VERSUS PROLONGED (5-10 YEARS)?

SHORT ANSWER - There are no specific data to indicate whether vegetation would respond differently under rapid or prolonged bison depopulation.

EXPLANATION - Without the benefit of specific data, it would be logical to expect that any habitat responses to removal of bison grazing would be more pronounced if bison depopulation were rapid rather than prolonged. If removal of bison grazing was known to be totally without effect on vegetation, then the rate of bison depopulation would be irrelevant from the point of view of habitat change. However, since these processes are not documented in the WBNP area, it is not possible to speculate on how rapid versus prolonged bison depopulation would change habitats. As it is, the present plan proposed by Agriculture Canada anticipates only one time frame - a short and rapid period of bison depopulation.

1.10 ARE THERE ANY VEGETATION TYPES OR PLANT SPECIES WHOSE PRESENCE IN THE PARK IS DEPENDENT ON CONTINUED USE BY BISON?

SHORT ANSWER - There is no evidence that certain plant species or vegetation types (habitats) in WBNP are there only because bison are present.

EXPLANATION - There is no shortage of theories about the influences of grazing animals upon their food plants. Loss of plant parts to grazers is often so conspicuous that grazing is automatically considered to be deleterious. However, there are theories which suggest that consumption by herbivores actually maximizes plant "fitness" (Owen and Wiegert 1976, Stenseth 1978). McNaughton (1983) advanced the idea that at low levels of grazing many plants have internal mechanisms to stimulate vegetative reproduction that may actually overcompensate for the forage lost to grazing. This theory goes so far as to suggest that natural selection tends to encourage moderate grazing of grasses (Coughenour 1985).

Ecological studies in North America have provided many examples of vegetation types that never change to what is considered to be the final (climax) stage of successional development. These examples of interrupted succession are generally a result of continuous distubance by human activities, by grazing, or burning, or grazing and burning combined. In the ecological literature these disturbed areas, which may be remarkably stable as long as the disturbance continues, are called 'disturbance climaxes' or 'disclimaxes' (Weaver and Clements 1938.)

Much of the theory and practice of range management for grazing animals is based on the concept of disturbance climaxes. It is therefore natural to wonder whether grazing by bison in WBNP has also led to disturbed habitats whose characteristics and presence are actually dependent on continued grazing. There have not been specific studies to directly address this question in WBNP. However, none of the people who have described WBNP bison habitat have suggested that bison were the cause of sufficient disturbance to create a vegetation type that was dependent on the disturbance. The most likely reason is the relatively low level of grazing relative to annual production by sedges and grasses in the vicinity of WBNP. This circumstance is in sharp contrast to the low levels of food production but high populations of plains bison, and later cattle, which characterized much of the short-grass prairie region. The idea of disturbance climax, which is such a central concept in grassland ecology, does not seem applicable to the grazed habitats within the boreal forest region around WBNP. For this reason, temporary removal of bison grazing under the program proposed by Agriculture Canada should not result in any marked successional changes to ecosystems now being grazed, simply because none of these habitats are now characterized by heavy disturbances from grazing.

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There is no indication that a reduction of bison would create a negative impact on other species that are prey for wolves (F. Messier, pers. comm., September 1989). Two of the wolf's prey species that have potential influences on vegetation are beaver and moose. If the beaver population cannot be predicted to either decrease or increase as a result of bison depopulation, there is no reason to suggest any possible changes in vegetation of beaver-controlled ecosystems.

In the case of moose, there is evidence that their population has increased as the bison population decreased in the SRL region. Therefore, any controls that moose exert over woody vegetation as a result of their browsing could be expected to increase as a result of bison depopulation.

1.11 ON AVERAGE, HOW MUCH BISON FOOD IS PRODUCED EACH YEAR IN WET MEADOWS AND IN DRY MEADOWS IN THE WBNP AREA?

SHORT ANSWER - The most detailed forage production data are from the Hook Lake area, east of the Slave River, where Reynolds and Peden (1987) recorded annual herbage yields of 4320 to 4480 kilograms per hectare (3853 to 3996 pounds per acre) in wet meadows and 1880 to 2680 kilograms per hectare (1677 to 2390 pounds per acre) in dry meadows.

EXPLANATION - The 1880 to 4320 kg/ha of annual forage production in the SRL, recorded in 1974 and 1975 by Reynolds and Peden (1987), is probably representative of many wet and dry meadows within WBNP. Some other examples of annual production in habitats used by bison are summarized below.

In the Nahanni region, wet sedge meadows and wet shrub bogs are the best habitats for bison. Other habitats are important as cover and provide additional forage for bison in certain seasons. The highest productivity (excluding tall shrubs and trees) of five habitats examined by Reynolds et al. (1980) in the Liard - South Nahanni rivers region was the wet sedge meadow. In these meadows average net annual yield of above-ground standing crop was 2,454 kg/ha. The lowest average annual yield of understory vegetation (331 kg/ha) was produced in spruce forests.

In Elk Island National Park, recorded annual forage production in the four main habitats was as follows: wet meadows, 3565 kg/ha/yr; grassland, 2900 kg/ha/yr; shrubland, 2630 kg/ha/yr; and aspen forest 2900 kg/ha/yr (Hudson and Blyth 1986).

Before a 1977 fire, sedge meadows used by bison near Farewell Lake, Alaska, produced about 1070 kg/ha of forage annually (Campbell and Hinkes 1983). These researchers did not record annual production per hectare after the 1977 fire.

Based on information summarized by Reynolds (1986), other recorded estimates of herbage yield in meadows used by bison are listed below:

Location	Average annual yield, kg/ha/yr Wet meadows	Dry meadows
Hay-Zama Lakes, Alberta, 1981	3530	-
Fort Providence, 1972	3486	2165
Fort Providence, 1973	1582	1242
Mackenzie Bison Sanctuary, 1977	3370	870
Nisling River, Yukon	1218	-

The data above reveal potentially large year-to-year variations in production. For example, there was a 55% drop from 3486 to 1582 kg/ha in 1972 and 1973, respectively, in the Fort Providence area. Overall, these annual forage yields, from relatively northern locations, are impressively high when compared to estimates from elsewhere. For example, a production estimate of 2615 kg/ha/yr was recorded by Reynolds (1986) for the foothills region of southwestern Alberta, and 563 to 915 kg/ha/yr for the short-grass prairie in Colorado.

In wet meadows in the Hook Lake study site, in addition to the 4320 to 4480 kg/ha of new green standing crop produced in 1974 and 1975, standing dead grass and grass litter averaged 2880 kg/ha. Standing dead grass and litter averaged 3120 kg/ha in dry meadows in 1975 (Reynolds and Peden 1987).

When carrying capacity is estimated for bison on the basis of annual forage yields, allowance must be made for the observation that bison in the Hook Lake area usually grazed only the top third of wet meadow plants (Reynolds et al. 1978).

1.12 IN THE VICINITY OF WBNP, HOW MANY BISON CAN BE SUPPORTED BY THE ANNUAL PRODUCTION IN WET MEADOWS AND DRY MEADOWS?

SHORT ANSWER - The average carrying capacity in wet and dry meadows in the Hook Lake area was estimated at 28 bison/km^2. In the Hay-Zama lakes area carrying capacity was estimated at 8 bison/km^2 on sedge and sedge-grass meadows combined.

EXPLANATION - The usual way to estimate bison carrying capacity is to assume that bison forage requirements are similar to cattle. For example, the Bison Disease Task Force (1988) used a figure of 11.3 kg (25 lb) of hay per bison per day. This is similar to the assumption by Reynolds et al. (1978) that one "animal unit" (one mature cow of 454 kg, with or without an unweaned calf at side) requires 11.8 kg dry matter per day or 4,307 kg/yr. The usable herbage estimate for an area or a specific meadow is divided by the annual requirement per animal unit (4,307 kg) to obtain an estimate of number of animals that can be supported on the area in question.

The estimate of a carrying capacity of 28 bison/km^2 for the Hook Lake area should be compared with other areas where carrying capacities are estimated to be much lower. For example, Reynolds (1986) recorded estimates of 8 bison/km^2 in the Hay-Zama Lakes area, Alberta, and 4 bison/km^2 in the Nisling River area, Yukon.

In the Farewell area, Alaska, Campbell and Hinkes (1983) estimated a carrying capacity of 2.5 bison/km².

On a regional scale, Novakowski and Choquette (1967) estimated that there was about 260 km² (100 mi²) of dry prairie and about 3100 km² (1200 mi²) of wet meadows available as summer and winter range for bison in WBNP. Less desirable range of muskeg-forest complex in the park was estimated to total 6475 km² (2500 mi²). The rest of the park is forest cover. Based on an assumed requirement of abour 24 ha (60 acres) per animal unit for a bison of average weight of 450 kg (1000 lb), Novakowski and Choquette (1967) estimated that the 3360 km² (1300 mi²) of wet and dry meadows in the park could support about 14,000 bison. A somewhat lower estimate is now used. For example, Agriculture Canada's proposed course of action to replace diseased bison in northern Canada with disease-free wood bison estimates that the carrying capacity of WBNP should be about 9,000 animals. This compares with an estimated carrying capacity of 3,000 bison in the SRL, 3,000 in the MBS and 3,000 in northern Alberta outside of WBNP.

1.13 ARE THERE VEGETATIONAL REASONS FOR THE INCREASING BISON POPULATION IN THE MBS AND THE DECREASING POPULATIONS IN WBNP AND SRL?

SHORT ANSWER - To date, no bison specialists have suggested forage availability as a controlling factor in northern areas where wood bison populations are either increasing or decreasing markedly.

EXPLANATION - As explained in the next question below, the rapid increase in the MBS population of bison is attributed to low incidence of disease, limited hunting and low predation by wolves. Ample forage is, of course, a prerequisite for bison population growth but in the case of the MBS it does not appear to be the cause of the rapid population increase.

In contrast to the MBS, bison in the SRL have displayed low rates of reproduction, low calf survival and low recruitment to the yearling class. Hunting, wolf predation and disease are considered to be the main negative factors in the SRL area. In addition, feeding by yearlings can be hampered in late winter by deep or dense snow (Reynolds and Hawley 1987a, Hawley and Reynolds 1987a). As in the MBS, availability of bison forage in SRL has not been identified by recent researchers as an important factor in the sharp shifts in bison populations.

1.14 IF WBNP WERE REPOPULATED WITH DISEASE-FREE BISON, WOULD THE PRESENT VEGETATION ALLOW A RATE OF POPULATION INCREASE SUCH AS HAS OCCURRED IN THE MBS?

SHORT ANSWER - Because of the high populations of bison that previously occurred in WBNP, relative to the present population, there is no reason to suspect that productivity of meadows would be a limiting factor for natural rates of increase of a disease-

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free herd of wood bison. This assumption is based on the opinion that the recent sharp decline in the park's bison population is not attributable to a limited food supply.

EXPLANATION - Assessments of forage production rates in the area of WBNP, based largely on data from the SRL (Reynolds et al. 1978, Hawley 1987, Reynolds and Peden 1987) indicate that in that region forage is abundant and not a limiting factor on free-ranging bison population numbers. However, Reynolds and Peden (1987) did recommend management policies to increase herbage production in communities with slough sedge and reed grasses by the use of prescribed burning. This implies that the present meadow vegetation does have the capacity to produce greater yields.

In the MBS, the very rapid recent increase in bison population was considered by Calef (1984) to be near the maximum rate of increase possible under natural conditions. Aside from the abundance of forage, other factors that have contributed to the rapid increase in the MBS population include: protection from hunting, low incidence of disease, and lack of predation by wolves (Reynolds and Hawley 1987a). If these potentially limiting factors were absent from bison populations in WBNP and SRL, there is reason to expect that there could be rapid recovery of bison populations, given the relatively high amount of forage available (Hawley and Reynolds 1987b). It is also significant that in wet meadows, based on observations in the Hook Lake area, only the upper one third of sedges are grazed (Reynolds et al. 1978). This suggests that forage production in the SRL-WBNP region could sustain rapid bison population increases, up to a certain point.

1.15 DOES FIRE HAVE A ROLE IN MAINTAINING THE SPECIES MAKE-UP AND PRODUCTIVITY OF HABITATS USED BY BISON IN THE WBNP?

SHORT ANSWER - In the WBNP region, wet meadows are more strongly influenced by hydrologic regimes than by fire history, but many of the drier meadows used by bison owe their existence to periodic fires.

EXPLANATION - Raup (1935) appears to have been the first investigator to suggest that grasslands in the vicinity of WBNP have persisted since deglaciation. As late as the 1950's other botanists appeared to be accepting Raup's hypothesis uncritically (Moss 1955). Holsworth (1960) was one of the first observers to challenge this hypothesis. In all of the prairies that Holsworth examined in WBNP there was evidences of previous forest fires. Furthermore, many of the grasslands that Raup observed in the 1920's were, by the time of Holsworth's observations, well advanced in their succession to forest. It is hard to imagine how grasslands could persist from the time of deglaciation until the 1920's and then suddenly be susceptible to invasion by shrubs, aspen and spruce. Holsworth concluded that the WBNP distribution of grasslands and forests was determined by their recent past history, especially fires, and not by soil or climatic conditions. Jeffrey's (1961) observations of vegetation

changes on the terrace at Peace Point since Raup's description of the same area in 1928 led him to the conclusion that the once more abundant prairies there may have been a result of more frequent fires.

The circumstances outlined above are in contrast to the grasslands that early explorers found within the boreal forest in the Peace River district of Alberta. In the latter area, in the triangle formed by the towns of Peace River, Grande Prairie and Fort St. John, the natural grasslands strongly coincide with the distribution of saline (solonetzic) soils (Wilkinson and Johnson 1983).

Holsworth's view that prairie areas in the vicinity of WBNP are fire-controlled is important for long-term management of bison range. If there were to be a program of successful fire suppression it would, in the long term, be in conflict with maintenance of bison summer range. Portions of the park to be managed as bison range require that fire be part of the long-term management plan (Holsworth 1960). If recent fire trends continue, this will not be hard to achieve. Statistics maintained at the Canadian Inter-Agency Forest Fire Centre indicate an unprecedented rise in the average forest area destroyed by fire annually in Canada. In the period from 1956 to 1966, an average of 600,000 hectares burned annually in Canada; from 1966 to 1976, the annual average was 1 million hectares and from 1976 to 1986 it was 2.3 million hectares. In 1989, by late summer before the fire season had ended, 2.57 million hectares had already been burned in the calendar year. If these trends continue there is reason to expect an expansion of potential wood bison range in the north.

In WBNP there could be a short-term reduction in the number of large fires that have characterized recent years, because of reduced amounts of high-hazard forest fuel. The extremely dry years of 1979, 1980 and 1981 led to the burning of over 20% of WBNP. Much of these large burns were through forested landscape with the result that large amounts of fuel have now been reduced over large areas of the park (Wein 1988).

The meadow vegetation model developed for WBNP by Wein and El-Bayoumi (1988) hypothesizes that a decrease in spring flood levels, as a result of regulation of flows in the Peace River, will lead to greater drying of meadow soils and higher probability of severe fires in meadow vegetation. The same model suggests that deep-burning fires, as in 1981 in WBNP, may alter organic soil-dominated sedge types to mineral soil-dominated prairie types of meadow.

There is evidence that sedge-grasslands that result from fire are a seral stage that persists approximately a decade unless burning is severe or further fire intervenes (Viereck and Schandelmeier 1980; Campbell and Hinkes 1983). A decision to manage habitat by fire therefore necessitates a commitment to re-burn to renew the seral stage. In this context, it was noted by Reynolds and Peden (1987) in the SLR that the large amount of standing dead grass and grass litter is an indication of the low

level of grazing relative to production, and that such dry matter accumulation may inhibit plant growth. Prescribed burning to increase yield combined with increased grazing intensity and more efficient range use by bison were recommended as management steps for these relatively productive areas (Reynolds and Peden 1987).

An example of fire's influence in restoring the proportion of grass- and sedge-dominated communities occurred in 1977 at Farewell Lake, Alaska. The amount of grass- and sedge-dominated communities increased from 190 km^2 to 438 km^2 within 4 years of the fire. Winter distribution of the Farewell bison herd (Campbell and Hinkes 1983) has expanded due to the fire-related habitat changes, primarily as a result of the conversion of 260 km^2 of open black spruce to sedge-grasslands. Habitats used by bison each winter after the fire were dominated by bluejoint grass and sedges. Prior to the fire, these sites had supported graminoid and low-shrub communities or open black spruce forest (Campbell and Hinkes 1983). In that area fire also contributed to expansion of winter range because snowpack in the former forest was greatly reduced when forest reverted to sedge grassland after the fire. Post-fire sedge grasslands are now contiguous with summer and pre-fire winter range in the Farewell Lake area.

The attractiveness of new grass on recent burns for grazing animals is well known. There are two reasons for this: the higher nutritive value of the new growth; and the absence of less nutritious and less palatable old leaves (De Vos 1969). In new grass that appears after a fire, indigestible material is usually reduced whereas protein and mineral contents are higher than in pre-burn grass.

Although no quantitative data are known for bison, there are data to show that cattle make impressively more rapid weight gains when grazing on recently burned versus long-unburned grassland. It is possible that the greater gains made by cattle grazing on burned grasslands might also be a result of factors other than the superior nutritive quality of the grass. For example, complete availability to the ground surface allows animals to consume a greater bulk in shorter time without spending much energy walking. Furthermore, each mouthful of grass from burned areas is not diluted by weathered straw of lower nutritive value (Daubenmire 1968).

The fact that post-fire grass is in many cases nutritious for animals can have negative effects. For example, where animals have unrestricted access to the new growth on a burn they sometimes keep it eaten down to the ground surface, which severely taxes the root reserves and jeopardizes the possibility of recovery. Fire that otherwise might stimulate increased productivity can in this way be indirectly devastating to grass (De Vos 1969). However, the degree to which this circumstance would apply to the relatively productive meadows in the WBNP area is not known.

Although there are abundant data to indicate superior nutritive values of grass after a burn, it is necessary to

interpret such data with caution. For example, increases or decreases of some chemical constituent can be influenced by the season of burning. In the tall-grass prairie, spring burning of big bluestem grassland increased protein content whereas burning in other seasons decreased it. Second, even if the percentage of protein is higher in post-fire grass shoots than it was before burning, fire sometimes thins a stand enough so that there could actually be less protein per unit area of land than there was before burning (Daubenmire 1968).

Burning to reduce the amount of unpalatable grass or sedge litter will not have very long-lasting effects. For example, in the tall-grass prairie of Illinois, 2 to 5 years was required as the time to equilibrium for litter restoration, and in grassy openings in Wisconsin forests it also took about 5 years for litter to return to pre-burn levels (Daubenmire 1968).

1.16 WHAT ARE THE FREQUENCIES OF FIRES AND SIZES OF AREAS BURNED IN WBNP IN RECENT DECADES?

SHORT ANSWER - From 1950 to 1985 the number of fires recorded in WBNP per year ranged from zero in several years to 25 in 1981. Sizes of recorded fires have ranged from about 200 ha to 183,000 ha. The two largest individual fires recorded in WBNP since 1950 both occurred in 1981 - the 183,000 ha fire in the Lynx Lake-Peace Point area and the 160,000 ha fire in the Buffalo River area.

EXPLANATION - For the Alberta portion of WBNP, Delisle and Hall (1987) mapped the locations of fires known to have occurred since 1931. Sizes of burns within the park are recorded, by year, in Attachment 2.

Many of Alberta's large fires have been inside WBNP. Since 1950, in the 20 years when fires were recorded in the park, the largest fire in all of Alberta occurred within the park in 8 of those years, and the second largest in 7 of those years. Although it may not be a representative year, in 1971 about 129,850 ha burned in the park. This represents 68% of the total area of 190,080 ha burned in Alberta that year.

One of the reasons for the notable difference in size of burns inside and outside the park is the more active fire suppression in more southerly areas of Alberta. Suppression has also reduced the frequency of fires in areas outside of WBNP. For example, Murphy (1988) reported that in northern mixedwood forests in 1909 any one point in that forest could, on average, be burned over once every 38 years. By 1929 the fire cycle had increased to 48 years and by 1969 it had become 90 years, based on averages. For the 1950 to 1969 interval specifically, the fire cycle had increased to 384 years in boreal and mixedwood areas where there was active fire suppression.

1.17 HAS CONTROLLED BURNING BEEN USED TO MAINTAIN OR IMPROVE WOOD BISON HABITAT?

SHORT ANSWER - No deliberate prescribed burning has been done to improve wood bison habitat, but considerable information has been obtained from observations following wild fires.

EXPLANATION - At the 18 April 1989 scoping session held in Fort Chipewyan, local residents expressed concerns about the deteriorating state of the Peace-Athabasca delta. They also suggested the need to rejuvenate bison habitat by prescribed burning to remove a build-up of dead hay and to control the invasion of other plants. The May 1989 presentation to the panel by the Sherwood Park Fish and Game Association cited Reynolds and Peden (1987) to make the point that there is a balance between meadow plant growth and grazing by bison, partly because a build-up of dead plant material in meadow habitat may inhibit further plant growth. This is one reason why burning is sometimes prescribed as a way to rehabilitate meadow growth.

Through the work of Ferguson (1979) and Lewis (1982, 1985) there is considerable documentation of the practices of native people in northern Canada to use fire in a creative way for habitat alteration. Ferguson, in particular, stressed the difference between 'causing' and 'creating' in the context of fire's influence on habitat. Her analysis of controlled burning methods used by the Slave Indians of northwestern Alberta is an example of using fire in a planned, creative way. Specific examples include the use of fire to: maintain grassland in areas where soil changes over time would favor succession to forest; create grasslands in areas where soil is particularly suitable for grass; create additional edges in forested areas; and to influence the distribution and number of many species of animals. Ferguson (1979) extended this aboriginal experience to today's setting by suggesting that native methods of controlled burning could be used to restore former hay meadows as a step towards re-introduction of bison to their former range. Controlled burning was also suggested as a way to destroy animal feces and dead grass which are often contaminated by anthrax spores and thus serve as infection sources for bison and horses. Furthermore, the use of controlled burning to reduce fire hazard, by elimination of high fuel build-up, is a management objective that should be attractive, not only to fire suppression agencies, but also Parks Canada and native people.

Lewis (1982, 1985) provided examples of native use of fire to eliminate fuel that could otherwise be a source of more serious fires at times of year when fire is environmentally undesirable. His documentation reveals a high level of sophistication and ecological understanding amongst native people in matters of fire control and the responses of plants and animals to different times, intensities and frequencies of fires. The extent to which burning was used to maintain meadows is revealed by the evidence that the large areas of open grassland between the towns of Slave Lake and High Level were there because of regular native burning (Lewis 1977).

Modern range management views controlled burning with many of the same objectives as described for native uses of fire. Bailey (1988) indicated that fire is used on rangelands for the following five basic purposes:

1. Modify species composition to favor preferred species over others through brush control; grass or forb control; seedbed creation favoring seeding establishment; and modifying species diversity.

2. Maintain or change a physical vegetation structure to provide a desired habitat for animals.

3. Improvement of forage quality through removal of litter; reduction of structural components; and increased mineral constituents of forage.

4. Modify forage production through increasing production; shifting the height of the main canopy to grow within reach of the herbivore; and increasing forage production by shifting species composition to favor forage species over non-forage species.

5. Fireproof stands of vegetation by using prescribed fire under predetermined conditions to remove excess fuel thus decreasing the risk of wildfire.

A study of the 1977 wildfire on the Farewell bison range in Alaska (Campbell and Hinkes 1983) led those researchers to recommend fire as a tool for managing northern bison habitats. In Alaska, wildfire in open black spruce forest and shrubland resulted in important bison winter habitat in the form of sedge-grass areas. In that area, bison accepted such habitat when it was adjacent to existing winter or summer range. The Alaskan researchers stressed that sedge-grass areas that result from fire are a short-lived successional stage and generally do not persist more than a decade unless burning is severe or repeated. As a result, a commitment to re-burn is necessary if there is a decision to manage bison habitat by fire.

Hudson and Blyth (1986) recommended a spring burning for bison habitat manipulation to remove litter, hasten growth and to open forest stands. Increases in productivity are offset by vigorous growth of **Calamagrostis** on moist sites. This coarse grass is unpalatable to many species and is of limited value as bison winter forage. Reynolds and Peden (1987) also regarded fire as a potential management tool, specifically for removal of dead plant matter in dry meadows to stimulate yields by prescribed burning.

The prescription for management of the MBS (NWT Department of Renewable Resources 1983) recommended small experimental burns in unused bison habitat. In this area, concern over fire use is for the safety of the bison present and the complexity of the role of fire in the development and perpetuation of sedge-grasslands.

1.18 ARE THERE OTHER RANGE MANAGEMENT OPTIONS THAT WOULD ENHANCE HABITAT FOR BISON USE?

SHORT ANSWER - For northern range used by wood bison, no other specific range management techniques have been developed to date.

EXPLANATION - The recommendation by Reynolds and Peden (1987) that prescribed fire be used to remove carry-over of litter implies that other management steps be considered to intensify consumption of the increased food supply. There is little point in burning to temporarily increase plant production if there are not opportunities to increase the size of the grazing population to take advantage of this extra resource.

1.19 INDEPENDENTLY OF THE INFLUENCES OF FIRE, BISON GRAZING AND ALTERED FLOOD REGIMES, WHAT ARE THE OVERALL LONG-TERM SUCCESSIONAL TRENDS OF VEGETATION IN THE PORTIONS OF WBNP MOST HEAVILY USED BY BISON?

SHORT ANSWER - The two fundamental successional processes defined by Fuller (1957) are still over-riding features of vegetation dynamics in the WBNP area. The first process is the steady progression of many vegetation types towards a climax spruce forest. This process has the general effect of reducing summer range for bison. More or less balancing this loss of range is the formation of new range by the silting in of the basin west of Lake Athabasca and the successional development of sedge meadows on newly exposed mudflats.

EXPLANATION - Based partly on an earlier review by Fuller and La Roi (1971), Carbyn et al. (1989) were of the opinion that the overall appearance of the Peace-Athabasca delta has probably not changed much in the last 300 years. At a local scale the delta is in a state of constant change but, on a broad scale, it is thought to have supported open unforested areas for a long time. Not knowing that flood regimes would be altered on the Peace River, Fuller in 1957 made the following statement about bison carrying capacity and bison distribution in WBNP:

> "In the forseeable future, the carrying capacity is not likely to change appreciably one way or another. However, a gradual population shift will likely occur as the forests occupy the prairies north of Peace River and sedge meadows arise from the mudflats of the delta south of the river."

The degree to which the suggested balance between successional development towards forest and successional development of new sedge areas has now been altered is extremely difficult to quantify. The most detailed information on vegetation dynamics within WBNP is for the Peace-Athabasca Delta, a 4,000 km^2 wetland complex at the western end of Lake Athabasca, which is only one part of the primary bison range within the park. The main reports on vegetation changes in the Peace Athabasca Delta are by Cordes (1975), Cordes and Strong (1976), Cordes and Pearce (1977, 1979) and Dirschl et al. (1974). Those studies were later supplemented with analyses of vegetation

changes detectable by digital landsat data (Wickware and Howarth 1981). The major habitats in the Peace-Athabasca Delta, listed in a sequence from habitats in the lowest topographic portions to those in the highest positions in the landscape, are summarized in Attachment 3.

The early work by Dabbs (1971), Dirschl (1970a,b; 1972) and the Peace-Athabasca Delta Project Group (1973) revealed that even small changes in water level can lead to rapid plant successional changes. These changes involve slough sedge (**Carex atherodes**) and reed grasses (**Calamagrostis** spp), the two most prominent plants in the diet of bison in this region (Reynolds et al. 1978).

1.20 IF FUTURE CLIMATIC CHANGE INVOLVES AN INCREASE IN MEAN ANNUAL TEMPERATURE IN THE VICINITY OF WBNP, OR GREATER YEAR-TO-YEAR VARIATION IN TEMPERATURES AND/OR PRECIPITATION, WHAT KIND OF VEGETATION CHANGES MIGHT BE EXPECTED IN WBNP?

SHORT ANSWER - Although much is being written today about the possibility of significant climatic shifts in the forseeable future, there is not a consensus on just what the climatic changes are apt to be. Even if it was known that average growing season temperatures were to increase by a certain number of degrees, it is unlikely that anyone could translate that information into specific predictions about changes in the habitats of prime importance for wood bison.

EXPLANATION - Speculation about the possible influence of climatic change upon wood bison habitat is of more than academic interest. In a 12 May 1989 scoping document prepared for the panel, the Canadian Wildlife Service stressed the need to consider how potential climatic changes might influence the boreal forest ecosystem. For example, if a grassland climate extended into the Mackenzie River basin, this could result in expansion of potential wood bison habitat. A larger population of disease-free wood bison throughout an expanded area of grassland in the Mackenzie River basin could be a significant economic resource.

Despite the difficulties of climatic change prediction, referred to in the short answer above, scientists have put forward enough hypotheses to bring this subject to the attention of the public, politicians and funders of research. For the boreal forest region of western Canada, it has been suggested that a doubling of atmospheric carbon dioxide could result in higher temperatures and drier summers, more frequent and intense fires (Singh 1988) and more severe insect and disease infestations. However, it is thought that the present dominant tree species would likely survive, maintaining the present species mix with possibly a slight increase in hardwoods (Zoltai 1989).

Predictions about the possible changes that could result from a doubling of atmospheric CO_2 include the suggestion of a

northward shift of the boreal zone (Zoltai 1988). Conditions favourable for boreal coniferous forests will, it is suggested, exist 300 to 450 km farther north than at present and the southern boundary would shift north approximately the same distance. Rizzo's (1988) predicted changes in ecoclimatic provinces resulting from a doubling of CO_2 suggested on expansion of grassland and transitional grassland into what is presently boreal forest, including the region around WBNP. Although no one can indicate the probability of these potential shifts in ecological zones, it is known from the work of Ritchie (1976) and others that there have been major north-south shifts before in the forest-grassland and forest-tundra boundaries in western and northern Canada. If drier conditions prevail in the future, and with future precipitation patterns an unknown (Singh and Higginbotham 1988), the future for wet and dry meadows in the WBNP region is difficult to predict.

Some of the predictions about potential climatically-induced vegetation changes in the boreal forest region are based on computer modelling. One example is the modelling approach developed by Pastor and Post (1988) which predicted an increase in forest productivity in cool, temperate forests if atmospheric carbon dioxide were to double in concentration. There is no obvious way to extend such modelling predictions to site-specific bison habitat productivity in wet and dry meadows of WBNP.

The hypotheses and climatic modelling activities outlined above, of necessity, focus on possible changes at the regional level, rather than on specific habitat types such as wet and dry meadows in WBNP. One could speculate that warmer and drier summers would favor reed grasses over slough sedge and that more frequent fires would favor prairie-like openings in boreal woodland areas, but there are now no detectable trends in that direction. In this century the successional trend has been towards invasion of shrubs and trees into unforested areas in the vicinity of WBNP. A reversal of this trend, which would likely result in a greater amount of desirable wood bison habitat, would require dramatic increases in fire frequency.

Even if there are major shifts to warmer and drier growing seasons, and more fires each year, the dominant ecosystem force will still be flood regime in much of the prime range now used by bison south of the Peace River in the park. For the Peace-Athabasca Delta there is good information on relationships between vegetation and flooding regime. If one could predict what a doubling of atmospheric carbon dioxide would do to the flood regime of the delta then one could make better predictions about possible changes to the wet meadows that are part of the prime bison habitat at present than can be done from the predicted northward shift of major vegetation zones such as the boreal forest.

Climatically-induced changes to vegetation in WBNP cannot be visualized for the relatively short duration of Agriculture Canada's proposed project to remedy the diseased bison problem. However, those planning the long-term future of free-roaming wood bison in northern latitudes have more reason to support future

research on potential climatically-induced expansion of bison habitat.

1.21 WOULD 'PURE' WOOD BISON BE EXPECTED TO USE DIFFERENT HABITATS AND VEGETATION TYPES THAN HYBRID BISON DO?

SHORT ANSWER - This question has not been specifically studied in the vicinity of WBNP. However, observations of the population in the MBS, considered to be 'pure' wood bison, indicate that they are as attracted to large, open sedge-grass areas as they are to smaller openings within boreal woodlands.

EXPLANATION - The question above is raised because there is evidence that wood bison in the vicinity of WBNP in very early times did not use the Peace-Athabasca Delta to the extent that they have since release of plains bison in the park (Carbyn et al. 1989). Does this imply that re-introduction of 'pure' wood bison to the park will result in abandonment of the large open areas of sedge-grass habitat which the hybrid bison found attractive in the delta portion of the park?

There is inconclusive evidence to date on whether wood bison and hybrid bison have different habitat preferences (Carbyn et al. 1989). Based on their natural geographic range, one might expect wood bison to prefer woodland vegetation and the vegetation of small prairies that are interspersed within boreal woodlands, whereas plains bison may have preferred the vegetation of larger, more open areas. However, future studies are needed to determine if habitat preferences change with the "purity" of a wood bison population. Documentation by Larter (1988) in the Fort Providence area indicates that, when conditions are ideal, the population present there, considered to be wood bison, use large meadows. This suggests that if WBNP were repopulated by 'pure' wood bison the large open sedge and grass area would not likely be abandoned as grazing habitat.

2. Habitat relationships for bison in Wood Buffalo National Park in the period since flood regimes were altered by Bennett Dam

2.1 WHAT ARE THE KNOWN RELATIONSHIPS BETWEEN DIFFERENT FLOOD LEVELS AND THE MAIN HABITATS USED BY BISON IN THE PEACE-ATHABASCA DELTA?

SHORT ANSWER - As water levels dropped between 1975 and 1978, field studies showed that the general succession trend at the margin of open water areas was from immature fen to sedge meadow. These vegetation communities stabilized as the difference between summer maximum and winter minimum water levels decreased. This trend probably continued into the 1980's as water levels have continued to be relatively low. The perched basins along the Peace River and at higher elevations in the delta do not appear to have been recharged since the major flood of 1974. Thus, as the perched basins have become drier, the earlier successional

communities are being replaced by more permanent species, such as willow and poplar.

EXPLANATION - The 1987 final report of the Peace-Athabasca Delta Implementation Committee (PADIC 1987) provides the latest hydrological and biological assessment of changes since construction of the W.A.C. Bennett Dam on the Peace River. PADIC was established in 1974 to coordinate programs to restore low water levels that had occurred in the delta area during filling of Williston Reservoir in 1968-71.

Under the auspices of PADIC, two rockfill weirs were constructed on Riviere des Rochers and Revillon Coupe to delay the rate of outflow and raise water levels throughout the delta. The committee also studied the growth of the natural diversion of water from the Athabasca River into the delta lakes through the Creed Creek breakthrough and the implications of this diversion on a possible control structure on the outlet of Mamawi Lake.

Amongst the conclusions reached by PADIC (1987), the following have a potential relationship to bison habitat:

The weirs will continue to perform as predicted and counteract many of the hydrological changes in the delta brought about by regulation of the Peace River by Bennett Dam;

The weirs have nearly restored the natural summer peak water levels of the delta, but the amplitude of water levels is less than under the natural regime;

Recharge of perched basins by overland flooding from the major delta lakes is similar to natural conditions; however, the weirs do not influence the perched basins flooded by the Peace river;

The naturally depressed water levels of the past decade have caused productive wetland habitat of the delta to decrease, particularly in the perched basins;

The water levels resulting from the weirs have mitigated many of the long-term biological impacts caused by the Bennett Dam and created a situation substantially closer to natural conditions than would have existed if they had not been built;

The perched basin habitat at higher elevations on the delta has been altered by less frequent flooding, and some perched basins along the Peace River have been lost;

The capacity of Creed Creek, a natural breakthrough from the Embarras River to Mamawi Creek, is growing. Breakthroughs such as Creed Creek are part of the natural evolution of the delta;

If Creed Creek continues to grow at its present rate, the ecological balance of Claire and Mamawi lakes will be affected.

Average annual flows of the three major contributory basins were compared by PADIC, using 1960-67 data to represent pre-Bennett Dam conditions and 1972-85 data to represent post-Bennett Dam conditions (Table 1). The average yield of all three basins has been slightly lower in the more recent period. From 1980 to 1985, however, average annual flows of the major contributory basins to the Peace-Athabasca Delta have been significantly below the long-term average (Table 2). This has contributed to low water levels on the Peace-Athabasca Delta in the 1980s.

TABLE 1

Average annual flows of the major contributory basins 1960-67, 1963-67 and 1972-85
(Source: PADIC 1987)

STREAM	PERIOD	AVERAGE ANNUAL FLOW (m^3/s)	
Athabasca River	1960-67	684	
	1972-85	684	
Difference		0	(0%)
Fond du Lac River	1963-67	331	
	1972-85	296	
Difference		35	(-10.6%)
Peace River	1960-67	2,270	
	1972-85	2,080	
Difference		190	(-8.4%)
TOTAL	1960-67	3,285	
	1972-85	3,060	
		225	(-6.8%)

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TABLE 2

Average annual flows of the major contributory basins 1960-79, 1963-79 and 1980-85
(Source: PADIC 1987)

STREAM	PERIOD	AVERAGE ANNUAL FLOW (m^3/s)	
Athabasca River	1960-79	698	
	1980-85	601	
Difference		97	(-13.9%)
Fond du Lac River	1963-79	310	
	1980-85	277	
Difference		33	(-10.6%)
Peace River	1960-79*	2,260	
	1980-85	1,850	
Difference		410	(-18.1%)
TOTAL	1960-79	3,268	
	1980-85	2,728	
		540	(-16.5%)

* Not including Williston Reservoir filling during 1968-1971.

Hydrological modelling by PADIC (1987) resulted in hydrographs which indicate that Bennett Dam regulation without the weirs would have resulted in significantly lower summer peak levels than would occur under the natural regime, but low levels experienced in the late winter would be approximately the same. The hydrographs show that although the weirs have closely restored the summer peak levels in the delta, winter levels have been increased, thereby producing a lower amplitude between the summer peaks and the winter lows in comparison to the former natural regime.

Vegetation changes in the Peace-Athabasca Delta were monitored annually between 1974 and 1978 along a series of transects established by the Canadian Wildlife Service in 1968. The monitoring programs were conducted for PADIC by the University of Calgary under contract to Parks Canada. They provide a basis for describing short-term vegetation responses to water level changes over the 1968-1978 monitoring period. Bison and moose were evaluated by PADIC in 1973 and no adverse impacts were predicted to occur from water level changes. Factors other than water levels, particularly hunting pressure and disease,

were thought to be more important determinants of population numbers (PADIC 1987).

Vegetation changes associated with above-average and below-average flood levels were summarized by PADIC (1987) as follows. With above-average water levels, all of the perched basins would be flooded and there would be an abundance of productive wetland vegetation types including submergents, emergents, immature fen and sedge meadows. With below-average water levels, there would be colonization by more permanent terrestrial vegetation, such as grass meadows and shrubs, particularly in the perched basins. The most dynamic communities and those most susceptible to water level fluctuations are the early successional communities located adjacent to the water's edge. These include the immature fen and sedge meadow communities.

As water levels dropped between 1975 and 1978, field studies showed that the general succession trend at the margin of open water areas was from immature fen to sedge meadow. These vegetation communities stabilized as the difference between summer maximum and winter minimum water levels decreased. This trend probably continued into the 1980's as water levels have continued to be relatively low (PADIC 1987).

Field observations have indicated that the perched basins along the Peace River and at higher elevations in the delta do not appear to have been recharged since the major flood of 1974. Thus, as the perched basins have become drier, the earlier successional communities are being replaced by more permanent species, such as willow and poplar (PADIC 1987).

The assessment of runoff from the river basins that contribute water to the Peace-Athabasca Delta showed that water yields have been relatively low in recent years. If water yields from the contributory basins increase, vegetation communities throughout those parts of the delta affected by the weirs can be expected to approach former natural conditions. Perched basins along the Peace River will flood only rarely, and vegetation succession in these perched basins will probably accelerate towards willow shrub communities. The width of productive habitat around the margins of open water areas can be expected to decrease somewhat, as the weirs have decreased the annual amplitude of water level fluctuations (PADIC 1987).

The wildlife simulation model developed by PADIC (1987) indicated that the productive vegetation communities of the delta would decrease by about 10% from the natural conditions, both with Bennett Dam only and with Bennett Dam plus weirs. However, the causes of the decrease would be different. The extreme low water levels that would have resulted from Bennett Dam without the weirs would have caused an increase in the extent of upland shrubs and forest vegetation and a significant decrease in the area of open water. The higher water levels caused by the weirs will result in a slight increase in the areas of both shrub and forest communities and open water, at the expense of the more productive communities. Carbyn et al. (1989) pointed out that most of the important summer bison ranges in the delta are not in

the immediate vicinity of the weirs and that it is questionable whether the weirs have had the desired effect. These authors pointed out that weirs raise the minimum water levels without increasing the maximum levels; from a habitat point of view the objective should have been flooding that would restore the former high water levels.

Despite the considerable monitoring to date, as recently as its 1987 final report, PADIC concluded that there was still a need for a long-term monitoring program to evaluate vegetational changes in the major habitat types, as they relate to water levels.

2.2 WHICH OF THE KNOWN VEGETATION CHANGES ATTRIBUTABLE TO ALTERED FLOOD REGIMES ARE OF MOST RELEVANCE TO WOOD BISON?

SHORT ANSWER - Open delta areas and perched basin in the Peace-Athabasca Delta portion of WBNP are the most important bison habitats under the influence of flood regimes.

EXPLANATION - The recent review by Carbyn et al. (1989) indicates that about 75% of the bison in the park use the delta during some part of the year. North of the Peace River, most of the important winter ranges are either directly associated with the Slave River and its tributaries and are not directly influenced by altered flood regimes. However, in the delta, two main components - open delta areas and perched basins - are important as bison range; they support delicately balanced plant communities that are dependent on the annual regimes of surface water and ground water. Most optimum bison range occurs on open delta land, primarily between elevations 209.25 m and 209.85 m above sea level (Cordes 1975). Significant flooding of these ranges occurs when the water level reaches 209.5 m.

Perched basins are also important as bison range. Perched basins begin flooding at 209.85 m. Because they are usually located at higher elevations than most of the delta and are not connected to the main drainage system by surface channels, they are generally not flooded every year. The proportion of perched basins that are flooded depends on the water level in the delta. For example, about 78% of perched basins are flooded at 210.3 m (Peace-Athabasca Delta Project Group 1973). Major floods of perched basins occurred during seven of the 20 years immediately prior to construction of the Bennett Dam; six of these floods occurred during the 1960's.

Backswamps, which occupy higher elevations in the delta, are less frequently inundated by flood waters and are less important as bison ranges than are perched basins and open delta lands, possibly because stagnation and incomplete plant decomposition render them nutritionally deficient (Carbyn et al. 1989).

As outlined in Section 1.1, sedge (**Carex atherodes**) meadows and reed grass (**Calamagrostis canadensis**) communities are the most important sources of food for bison, with up to 70% of the bison's annual diet and almost 100% of it's winter diet made up

of these two genera (Reyno'ds et al. 1978). It is the sedge meadows that are most frequently flooded and their maintenance actually requires periodic, short-term, flooding. **Calamagrostis** communities occur on higher ground that floods less frequently. This type of vegetation, which is at the lower end of the successional scale, responds more rapidly to changes in the hydrological regime than does vegetation at the upper end of the scale such as deciduous or coniferous forests. The review by Carbyn et al. (1989) pointed out that when sedges are covered by standing water caused by flooding, the result is poor vigour, low seed production (Cordes 1975), and the growth of long stems (up to 2 m) that are too weak to support the plant, so that the stems float on the water's surface (Cooper 1974). When high water levels persist, sedges lose their vigour and eventually die (Dirsch et al. 1974, Cordes 1975).

If prolonged flooding has occurred, short-term drought conditions can have a positive effect on bison ranges by allowing areas that had been too wet to dry out. However, since sedges thrive best in very specific moisture conditions, a prolonged drought would eventually result in the loss of sedge habitat. Since **Carex** and **Calamagrostis** can become established or eliminated within 3 or 4 years, prolonged flooding or drought conditions can have far-reaching effects on the total amount of bison range. Fortunately, the general diversity of levees, channels, ponds, and perched basins provides a range of opportunities (Carbyn et al. 1989).

Relationships between water levels and bison range north of the Peace River have not been studied (Carbyn et al. 1989).

3. Vegetational considerations for the main options dealing with the diseased bison population of WBNP

The panel has the mandate to examine all reasonable courses of action to achieve the objective of eliminating the bison disease problem in WBNP. These shall include, but need not be limited to, the four possible courses of action mentioned by the Bison Disease Task Force. These four alternatives were:

1. Status quo - no change.

2. Fencing of WBNP to contain the diseased bison and prevent the spread of the diseases beyond the park boundaries.

3. Phased elimination of the diseased hybrid bison herd and replacement with a disease-free wood bison breeding herd. This could include an examination of efforts to identify and salvage wood bison genetic stock from the existing herd.

4. Composite plan to confine the disease to the park by a combination of strategically placed fences and buffer zones exterior to the park where bison would be eliminated, and land-use restrictions.

For purposes of this review, the options listed above were not analyzed individually in terms of possible effects on bison habitat. The program proposed by Agriculture Canada was taken as the most likely course of action, although it is recognized that the panel may propose amendments to that course of action or perhaps an entirely different approach.

The main conclusions of this review of vegetation concerns are listed below.

1. The greatest vegetation disturbances will occur where corrals and fences are proposed for construction at Sweetgrass, Hay Camp, Hanging Ice Bison Ranch, Hook Lake, and Mackenzie Bison Sanctuary. The areas potentially involved in these facilities would be as follows:

Corral at Sweetgrass	1 km²
Corral at Hay Camp	1 km²
Corral at Hanging Ice Bison Ranch	1 km²
Corral at Hook Lake	1 km²
Corral at Mackenzie Bison Sanctuary	1 km²
Double-fenced enclosure at Hanging Ice Bison Ranch	10 km²
Double-fenced enclosure at Hook Lake	10 km²
Double-fenced enclosure at Sweetgrass	100 km²
Double-fenced enclosure at Hay Camp	100 km²
Double-fenced enclosure at Mackenzie Bison Sanctuary	100 km²

These structures would result in at least 5 km² of very intensive vegetation disturbance, of which 2 km² would be within WBNP. The double-fenced areas would receive greater-than-average grazing pressure when used for holding bison. They would total 320 km² of which 200 km² would be within WBNP.

2. From the point of view of Parks Canada, an important guideline is to prevent or minimize opportunities for introduced plant species in the park. The degree to which there will be risk of plant introductions from imported hay will depend upon the rate at which repopulation is planned for disease-free bison. If the goal is to maximize the number of bison available for release into WBNP, then feeding of bison in corrals will be necessary and imported hay may also be required. The risk of introducing plants can be lessened if only local hay were harvested, if replacement bison were raised in other locations outside the park, or if the replacement herds were built up at a slower rate that might eliminate the need for feeding. Release of disease-free animals as early as possible will also reduce the need for supplementary feeding. Even if feeding is minimized, there may be a need to use hay to bait bison towards wing fences or corral gates. If hay is required for this

purpose, use of locally produced hay would obviously be preferable if Parks Canada wishes to minimize the distribution of seeds of introduced plants. Instead of bringing hay into holding areas, burning to encourage new grass with a higher protein content should be considered (R. Berg, pers. comm., September 1989).

3. Agriculture Canada's proposal emphasizes that bison holding areas would be established only at locations that are already disturbed, namely Hay Camp and Sweetgrass Landing. Insofar as there are already introduced plant species at those locations within the park, this is a prudent choice for location of holding corrals. If bison in holding areas must be fed and if park-produced hay is inadequate, it would be preferable to concentrate imported hay in areas that already contain introduced plant species. Such concentration would make it easier for Parks Canada to eradicate exotic plant species, if that were to become a high priority activity some time in the future.

4. Agriculture Canada did not address the question of carrying capacity in the proposed holding areas. A goal of no more than 10 bison/km^2 may be reasonable for holding areas but it is not clear whether this is the objective. There are also unanswered questions about the need to feed. Without specific information, it should probably be assumed that cows would need to be fed in winter. However, this need could possibly be reduced if the proposed holding areas were enlarged or if prime range was selected for holding areas to provide the maximum stocking rate. The latter idea must be balanced against Agriculture Canada's suggestion to locate the two large holding areas in sites that are already disturbed at Sweetgrass Landing and Hay Camp.

5. It does not appear possible, from available information, to indicate that the decreasing bison population in WBNP is a result of vegetation changes since flood regimes were altered on the Peace River. However, it is recognized, if not quantified for the entire delta area, that there has been a decrease in sedge abundance and increase in grasses since flood regimes were altered.

6. It is not possible to predict specific changes that may occur to wet and dry meadows in the WBNP area if some of the predicted climatic changes occur. The ability of bison to survive in a wide variety of habitats is well recognized (Tempany and Cooper 1975) and one can speculate that bison would therefore be adaptable to climate-induced habitat changes. Northern forage could become relatively more important than it already is if drier years in the future make forage even more scarce in southern parts of the prairie provinces.

7. The potential for increased shrub invasion into grasslands during temporary removal of bison grazing has

the potential to be offset by increased moose browsing of shrubs if the moose population were to substantially increase during the bison depopulation phase.

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ATTACHMENT 1

Summary of bison use of WBNP vegetation types (Source: Fuller 1962)

Vegetation	Extent	Use by bison
Forest		
White spruce	Climax widely distributed on heavier soils	Shelter from winter storms
Jack pine	Edaphic subclimax widely distributed on lighter soils	Shelter, dust wallows, major migratory routes
Aspen	Widely distributed following fire and in early successional stages	Shelter; forest floor contains grasses and legumes, giving some summer forage
Black poplar	Confined to stream banks, particularly delta channels	Very little used
Upland prairie		
Openings in forest	Three chief areas of considerable extent. Probably confined to clayey soils	Important summer range
Salt plains	Long narrow strip along eastern margin of park	Mainly winter range, but also used in summer
Sink holes	Widely scattered in gypsiferous terrain of eastern edge Alberta Plateau	Summer forage in forest areas otherwise lacking in food species
Lowland meadows		
Delta plains	Combined delta of Peace and Athabasca Rivers	Important year-round range
River flood plains	Chiefly along Peace and Slave Rivers	Mainly winter range, but also used in summer
Marshy lake margins	Widely distributed throughout the park, especially Alberta Plateau	Summer forage in forest areas otherwise lacking in food
Muskeg (peat bog)	Widely distributed - many of considerable area	Generally avoided

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ATTACHMENT 2

Recorded burns in the Alberta portion of WBNP from 1950 to 1985 (Source: Delisle and Hall 1987)

Fire No.	General location	Year	Area of burn, ha*
881	Jodoin Creek	1950	252
882	Garden Creek	1950	12,849
883	McIvor Creek	1950	45,844
884	Flatgrass Lake	1950	266
898	Garden Creek	1951	633
934	French Lake	1952	41,591
935	Harper Creek	1952	1,386
936	Embarras River	1952	420
980	Burrison Lake	1953	1,141
981	Robertson Lake	1953	233
982	Birch Lake	1953	62,012
983	Robertson Lake	1953	1,378
984	Birch River Delta	1953	75,513
985	Lake Claire	1953	128,554
986	Boyer Rapids	1953	11,878
1044	Kennedy Lake	1955	851
1045	Welstead Lake	1955	33,595
1046	McNeil Lake	1955	308
1047	Arrowhead Lake	1955	8,225
1048	Peltier Creek	1955	1,706
1049	Buffalo River-Snake Lake	1955	21,821
1050	Carlson Landing	1955	2,234
1051	Revillon Coupe	1955	202
1052	Buffalo River	1955	389
1121	Pushup Lake	1956	296
1122	Mink Lake	1956	316
1185	Otter Lake	1959	4,983
1245	Johnson Lake	1962	985
1348	Merryweather Lake	1969	3,484
1365	Whitesand River	1970	26,305
1382	Ninishith Hills	1970	3,383
1383	Berry Creek	1970	1,434
1384	Sass Lake	1970	5,051
1385	Tourangeau Creek	1970	15,378
1414	Burrison Lake	1971	4,435
1415	Boyer Rapids	1971	12,238
1416	Ninishith Hills	1971	21,756
1417	Mamawi Lake	1971	348

* Areas refer to the entire burn, not just the portion of a burn within the park. At least nine of the listed burns crossed the park boundary. Therefore the total area burned within the park will be less than the total of the last column in this table. Furthermore, some burns occurred on areas that had already been burned once since 1950, so that addition of the last column results in some "double counting" of areas burned.

Fire No.	General location	Year	Area of burn, ha*
1418	Whitesand River	1971	6,058
1419	Buchan Lake	1971	40,404
1420	Salt River	1971	486
1421	Jackfish River	1971	3,108
1422	McNeil Lake	1971	17,596
1423	Upland Lake	1971	29,469
1446	Merryweather Lake	1973	590
1474	Whitesand River	1977	4,866
1501	Buffalo River	1979	440
1502	Davidson Lake	1979	4,772
1503	Jodoin Creek	1979	5,364
1504	Boyer Rapids	1979	518
1505	Birch River	1979	4,533
1506	Buffalo River	1979	850
1507	Robertson Lake	1979	16,123
1508	Lane Lake	1979	2,475
1509	Garden Creek	1979	233
1551	Beaver Indian River	1980	103,686
1552	Alice Creek	1980	3,339
1553	Vermilion Lake	1980	486
1554	Birch River	1980	7,891
1555	Birch River	1980	354
1556	Ninishith Hills	1980	19,324
1557	Stovel Lake	1980	11,837
1558	Robertson Lake	1980	29,793
1559	Thultue Lake	1980	8,195
1560	Lake Claire	1980	13,456
1561	Boyer Rapids	1980	3,339
1562	Robertson Lake	1980	233
1574	Buffalo River	1981	3,108
1578	Buchan lake	1981	32,375
1593	Modere Creek	1981	519
1594	Lake Claire	1981	907
1595	Birch River	1981	23,306
1596	Birch River	1981	202
1597	Baril River	1981	518
1598	Hilda Lake	1981	6,475
1599	Lynx Lake - Peace Point	1981	183,373
1600	Boyer Rapids	1981	8,286
1601	Buffalo River	1981	160,322
1602	Lake Claire	1981	1,036
1603	Big Island	1981	259
1604	Lake Claire	1981	518
1605	Portage Lake	1981	5,439
1606	Buffalo River	1981	303
1607	Buffalo River	1981	475
1608	Kenny Woods	1981	53,613
1609	Whitesand River	1981	6,010
1610	Whitesand River	1981	202
1611	Meridian Lake	1981	2,367
1612	McIvor River	1981	29,340
1613	McIvor River	1981	354
1614	Brousseau Creek	1981	55,685
1615	Swift Current Creek	1981	28,231

Fire No.	General location	Year	Area of burn, ha*
1672	Buffalo River	1982	202
1676	Buffalo River	1983	639
--	Chenal Des Quatres Fourches	1984	407
--	Whitesand River	1984	1,311
--	Meridian Lakes	1984	2,009
--	Buffalo River	1984	468
--	Steepbank River	1985	4,727

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ATTACHMENT 3

Names and descriptions of major habitats in the Peace-Athabasca Delta (Source: Wickware and Howarth 1981)

HABITAT	DESCRIPTION
Turbid Open Water	Flooded area generally devoid of emergent vegetation.
Less Turbid Open Water	Flooded area, often with emergent vegetation (**Scirpus** spp). It is found in protected embayments of larger lakes and in smaller perched basins.
Scolochloa/Scolochloa-Carex	Inundated area with erect living vegetation whose normal habitat requires continual flood inundation (**Scolochloa/Scolochloa-Carex** group most frequently occurring community). Wetter **Carex** meadows also occur.
Wet Carex Fen	Inundated area with lower water levels than in the **Scolochloa/ Scolochloa-Carex** communities. Some **Scolochloa** may also occur, however. Growth is moderately dense and semivigorous.
Carex/Calamagrostis Fen	Dense vigorously growing **Carex/ Calamagrostis** on sites less wet than those of the wet **Carex** meadows. Vigorously growing immature fen species may also occur in this class.
Shrub Fen	Area dominated by Salix shrubs, **Calamagrostis** meadows and drier **Carex** meadows.
Salix-Alnus-Populus	Areas dominated by tall deciduous shrubs (**Salix/Alnus**) and/or tree species (**Populus**). Usually occur along well drained river levees, Precambrian rock outcrops or older better drained areas of the deltas.
Picea-Populus	Areas dominated by coniferous forest species of white spruce and balsam fir. Balsam poplar and white birch are scattered throughout.

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NATIVE PERSPECTIVES

ON THE NORTHERN DISEASED BISON ISSUE:

AN OUTLINE

A REPORT PRESENTED TO:

THE NORTHERN DISEASED BISON
ENVIRONMENTAL ASSESSMENT PANEL

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October 15, 1989

NATIVE PERSPECTIVES ON THE NORTHERN DISEASED BISON ISSUE: AN OUTLINE

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1. Role of the Native Perspectives Report in the Panel Review Process

The Northern Diseased Bison Environmental Assessment Panel was appointed in February 1989 to review the issues associated with a herd of diseased, hybrid bison inhabiting lands in and around Wood Buffalo National Park (WBNP). The perception of the existence of this herd as a problem is outlined in the report of the Diseased Bison Task Force[1], the members of which represent a number of provincial, territorial and federal government agencies. This Task Force report also defines a number of possible solutions and identifies the one which it feels best answers all government agency concerns: the replacement of the existing herd with a wood bison herd.

The task of the Panel is to "publicly review, in a sufficiently broad manner so as to include balanced local, regional and national perspectives, the environmental, resource conservation, socio-economic and health implications associated with the management options identified in the Task Force Report".[2]

The 'Issues Scoping' stage of the Panel review identified a number of critical areas on which the Panel requires more information. These gaps in information are being addressed in the Information Requirements stage, now coming to an end. Among the critical areas on which more information was required is the perspective of the Native communities on this issue, including the significance of the bison to the people and the perceived impact of the different proposed management options on the lives of Native people in the communities around WBNP.

My role is to assist in summarizing for the Panel these local Native concerns and perspectives as expressed in more informal discussions than was possible in the Issues Scoping process (Appendix A). This report is based on such discussions held with concerned individuals in each community (Appendix B); and on the responses to a draft of this report which was circulated to the communities involved. The lack of direct input from the Little Red River Tribal Administration arises from that group's decision not to participate in this process pending resolution of their negotiations for intervenor funding to hire their own consultants. These negotiations were concluded in time for Little Red River Tribal Administration to comment on the draft report. They feel that this report reflects, in general, much of their own position on this particular issue.[3]

The function of this report is to further the dialogue between the Panel and the Native communities[4]. It is intended to provide for the Panel a summary of specific concerns as well as contextual information necessary to interpret individual statements heard in community meetings. Equally so, refinements or enlargements on aspects of this report may serve Native groups as a useful point of departure for their own more specific proposals concerning the bison management issue.

2. Introduction

Local Native peoples have made it very clear that they have strong concerns about the bison and bison management; about the management option favoured by the Diseased Bison Task Force report; and even about the review process itself.

The statements summarized in this report primarily address the issue of how real is the problem as defined by the Diseased Bison Task Force and what is the real problem as defined by local Native people. The advantage in any debate goes to the party which initially defines the problem since subsequent discussion is often very much directed by that definition. The recognition by Native people of this 'edge' enjoyed by the Task Force report and its recommendations contributes to a perception of the Panel review as already biassed.

The consistency of the critique offered by the different communities is quite striking and establishes a very strong position on this issue. One line of diversity emerging from these discussions is between those communities which are bison-harvesters and Park-users and those communities which are not. The latter's presentations are more restrained and members of these communities express a reluctance to see local concerns used to support solutions which would have the greatest impact on the communities abutting WBNP. Indeed, there is some scepticism about whether the consultation process is being used to manipulate them in just such a way.

The local Native critique is presented herein as a series of challenges to specific major points contained in the definition of the problem as provided by the Diseased Bison Task Force's report. The favoured option of substituting wood bison is also challenged. Lastly, the re-definition of the problem by the local communities is outlined in general terms.

3. Defining the Problem: The Perspective of the Diseased Bison Task Force Report

3.1 THE DISEASED BISON TASK FORCE REPORT'S DEFINITION

The problem as defined by the Diseased Bison Task Force report states that the bison of the WBNP area are:

1. diseased with tuberculosis (35.8%) and brucellosis (35.6%), posing a threat to the health of bison-users, other wildlife species and domestic cattle in the area. The latter threat has additional implications in that it interferes with Canada's credibility as a country with a brucellosis-free national cattle herd and with the national program to free these herds from tuberculosis by the end of 1989.

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2. cross-bred wood bison and plains bison, the existence of which endangers the Wood Bison Recovery Program. This program is designed to promote the establishment and growth of wood bison populations to the point where this subspecies is no longer considered 'endangered' or 'threatened'. The program has more specifically defined a goal of re-introducing wood bison into its' historic range which includes the geographic area under discussion here. The hybrid herd now in the WBNP area is a threat to the genetic integrity of the wood bison herds.

3.2 NATIVE PEOPLES' PERSPECTIVES ON THIS DEFINITION OF THE PROBLEM

3.2.1 Perspectives on the Incidence of Disease

Overwhelmingly, Native groups and individuals challenge the Task Force's statement that the bison of the WBNP area currently suffer such a high rate of disease.

The incongruity between the hunters' own observations in butchering bison and the conclusions offered by the Task Force leads the local people to question the biological data. People speculate that such figures are derived from samples which are too small or which do not involve a representative selection of age and sex groups. Whether this data reflects current disease rates is also questioned.

Some hunters attempt to estimate how many of the Slave River Lowland bison harvested over the past years were diseased and conclude that it was 10% or less. Others feel that the Hook Lake herd, in particular, is now disease-free. Tallcree representatives have no perception of the Wabasca herd ever having been diseased. Fort Chipewyan harvesters refer to the 1970 hunt where 200 bison were taken from different parts of southern WBNP. The attending veterinarian determined that six individuals (3%) were diseased.

Most of these comments appear to be directed towards tuberculosis specifically.

A recommendation to test the figures cited in the Task Force report on the incidence of disease is being discussed. Biologists would either accompany Native harvesters on special harvests in different areas of WBNP taking a large enough sample to be significant; or alternatively would examine live animals.

Although Native people recognize that any frequency of these diseases in the bison herds might be unacceptable to cattle ranchers, the strategy indicated in this discussed recommendation is informed by a perspective

which sees a certain incidence of disease in a population as natural and even inevitable.

3.2.2 Perspectives on the Issue of Genetic Integrity

Subspecies purity is not a valued concept to local Native peoples. The establishment of a wood bison population in itself is seen as a worthwhile endeavour but the slaughter of another bison population to make way for wood bison is seen as irrational. Why place a higher value on an animal which is, let's say, 90% wood bison, 10% plains bison than on an animal which is 90% plains bison, 10% wood bison?

From the harvester's point of view, the value of the two subspecies is seen as the same: "they both taste the same". Over and above this, Native people commented that this EuroCanadian cultural value on subspecies purity is actually a dangerous philosophy. Several people drew analogies to racism, an analogy which was offered with a smile but which is not facetious. Analogies between humans and animals are logical, given the aboriginal belief in the relatively equal standing of the different species, as we shall discuss later.

3.2.3 Perspectives on the Issue of Possible Contact between Bison of the WBNP Area and Herds of Cattle and/or Wood Bison.

Two routes of contact are discussed here: contact between wood bison in the MacKenzie Bison Sanctuary and hybrid bison in the WBNP area; and contact between WBNP area bison and cattle in the Fort Vermilion - High Level area and wood bison in the Hay-Zama area. Input from the Little Red River band is certainly needed on the frequency of bison moving out from the southwest area of the Park.

While no one argues that such migration is impossible, no one feels it is a major threat either. There is a certain amount of scepticism about the reported sightings of errant bison in the Fort Vermilion-High Level area and the possibility entertained that these individuals sighted actually come from the plains bison ranch at Fort Vermilion. Tallcree band members state that individuals from the Wabasca herd occasionally cross the river but feel that the lifespan of these bison is subsequently rather short. Representatives from Fort Providence think that an adequately monitored buffer zone between the Mackenzie Bison Sanctuary and WBNP would be sufficient for the time being. The Dene Th'a report that they are unaware of any WBNP area bison penetrating their area but say that several bison were observed in 1983 or 1984 around the Hay-Zama Lakes. These were thought to be wood bison from the Nahanni Butte herd.

3.2.4 Perspectives on the Issue of the Threat to the Health of the Harvesters

Harvesters feel quite confident that the harvesting of diseased bison over the past decades has not proven injurious to their health. Butchering and cooking practices are credited with being sufficient to eliminate any risk. People comment on the times they've eaten meat from an animal with a tubercular lung or shoulder and experienced no health problems. As one Fort Resolution harvester said, "I'd rather eat meat from a buffalo with some tuberculosis than beef from cattle that is full of chemicals. The buffalo have been eating good, natural food, not fed with hormones and chemicals."

3.2.5 Perspectives on Whether Disease Issues are Adequately Addressed By Focusing on the Hybrid Bison Herd.

Native people are not convinced at all of the extremity of the problem as stated by the Task Force report, but if a potential problem does exist, they question whether a solution focusing solely on the bison herd will be at all effective. Their critique expands the scope of the problem to consider other sources of these diseases in the natural and social environment.

Native people are very much aware that disease operates within a system. One Hay River elder speaks of the bison as standing on a "floor", a "floor" shared by other species. Can disease organisms in the bodily wastes of infected bison contaminate soil and vegetation and be thus passed onto other bison? Several people suggested the use of prescribed burning to clean up meadows intensively used by diseased bison individuals. To what extent do other species harbour these diseases? What are the risks of disease transmission through predators and scavengers such as wolves and ravens which can travel long distances? These questions surfaced in the Issues Scoping stage and will surface again and again until people feel that enough is known about the maintenance and transmission of these diseases to make informed decisions.

There are also socio-economic aspects to this broadening of the scope of the problem, particularly to do with the transport of domesticated animals. Fort Providence representatives question that if the introduction of disease to the wood bison herds in the Mackenzie Bison Sanctuary is the main concern, why are domesticated animals not tested prior to entering the Northwest Territories from Alberta.

In a similar vein but with reference to diseases in general, a Boyer River representative notes that band members are concerned about disease being transmitted to their cattle but they see the most immediate threat as, not the hybrid herds of the WBNP area, but the non-local cattle which are shipped into the Fort Vermilion grazing preserve. Cattle introduced from other geographic areas are seen as possibly introducing different strains of

disease and as a group in which disease transmission has been promoted by the crowded conditions of shipping or previous overstocking on southern pastures.

There is another source of disease about which certain individuals hypothesize: EuroCanadian management techniques themselves. There is much criticism of the bison management techniques practised in the past, particularly those that involved driving by helicopter, herding, corralling etc.[6] Managers themselves acknowledge that many of these techniques caused wounding and high mortality, particularly among calves. Some harvesters observe that harvested animals which prove to be diseased often bear some indication, eg. ear tag, that they have been vaccinated and/or handled in some way. They suggest that either the vaccination itself causes the disease or that the stress created in the animal by the handling makes it less resistant to infection.

The implications of the existence of other sources of these diseases are a major concern to people. What will government agencies do if a wood bison herd introduced to the WBNP area becomes infected through other sources? Disease is very difficult to control in wildlife population. Will all wildlife come to be regarded as a threat to domesticated animals?

3.2.6 Perspectives on the Wood Bison Substitution Option

People from the local Native communities all addressed the question of the hybrid slaughter and wood bison substitution option. Reaction varies from distaste and concern over such a strategy to downright rejection.

The ecological arguments against such a strategy include the point made above about the maintenance and transmission of these diseases in and through other components of the environment, including human practises of managing both wildlife and domesticated animals. Would slaughtering the WBNP area bison actually eradicate these diseases?

Bison harvesters and Park-users also feel that the implications of removing a major prey species from the ecosystem are potentially disastrous.

> "If the buffalo only are killed, the wolves won't just move away. First, they'll clean out the country of all the wildlife - moose, woodland caribou and the small stuff too. There'll be nothing left here."

Can the impact of wolf predation on other prey such as moose and fur-bearing animals be mitigated by introducing a wolf control program at the

same time? This issue, raised at the Issues Scoping sessions, continues to be a major concern.

"Drastic problems require drastic solutions" may be a stirring motto to some but Native people refer to the fact that this alleged "drastic problem" was created by just such a philosophy operating in the past. The management decision taken in 1926 to transport diseased plains bison north started out as a 'drastic solution' to problems at the Wainwright game reserve. Not enough was known about the ramifications of the solution. The problems created have resulted in most of the subsequent bison management programs in WBNP, including this proposal. Native people are understandably reluctant to see this particular proposed solution engender several more generations of biological problems and management solutions to which they will be asked to adjust.

A final comment on this option derives from the religious or philosophical perspective of aboriginal peoples on wildlife and on the relationship between humans and other species. Although very little explicit discussion of religious/philosophical beliefs took place at these community meetings, it is clear that many statements made by community members are informed by a distinctive philosophical background.

However, it is beyond the scope of this report and, indeed, beyond my abilities, to provide any kind of comprehensive statement on this topic. A growing body of literature on this topic[6] may allow one to draw a general contrast between Native Canadian and EuroCanadian ideas about the relationship between humans and wildlife. One caveat is that such a general contrast does not do justice to the differences which exist between Native cultures themselves, as in, for instance, the philosophies of the Dene and the Cree.

The anthropologist, J. W. Bennett[7] observes that a society sees its' relationship with the natural environment operating on much the same terms as relations between its own members. An egalitarian society tends to see its relations with another species as a fairly equal one. Kinship, so important in the organization of social relations in an egalitarian society is often extended at least metaphorically to the natural world. On the other hand, a stratified society tends to see its relations with the environment as an unequal one with humans as the "upper class", so to speak.

The use of an analogy between humans and other species has thus more logical force in a culture that is traditionally egalitarian than it does in a socially stratified culture. This kind of analogy is employed in the comments on bison racism (3.2.2). Its use also leads, in the case of this issue, to speculations about how people with disease are viewed. If the bison could be destroyed because they are diseased, could people be destroyed too for the same reason? Are the Indians next?

Some harvesters use this logic to argue that, if the bison are so sick, they should be treated, just as when people are sick. Others argue that Nature would make the balance and that these processes should continue unhindered.

Other comments made by community members reflect the idea that harvested animals are owed respect. This is one aspect of the reciprocal relationship between harvesters and harvested. The idea that hunters could be on an equal footing with other species founders in EuroCanadian logic on the perception that the act of killing must always involve a denial of all rights to that which is killed. For many Native Canadian cultures, it appears that the essence of this equality lies in a relationship of mutual rights and obligations operating between the hunter and the hunted. Humans have the right to feed themselves and for many Native Canadian groups, the harvest is an event in which the animal is given to the hunter.

In return, the harvested animal still has rights. One of these rights is that of respect from the harvester. This respect is shown in part by the harvesters taking only the number of animals that they require for their comfortable survival. Native harvesters are concerned about the potential for wastage of meat from herds in remote areas of the Park under this option. Respect for the animal is also shown in the manner of killing. There is concern about the potential for causing distress to the animals in any slaughter that may involve, for instance, driving by helicopters.

Community members also point out that people have a responsibility to harvest animals to prevent either their outstripping the feed available to them or their becoming diseased. This idea clearly implies that the reciprocal relationship between humans and animals is worked out on a population level, a level beyond that of individual harvest events.

Finally, in more general cultural terms, involvement in hunting and trapping is an important part of Native life in the North. When solutions to perceived problems are proposed which have their main impact on the wildlife populations used by Native peoples, they see this as an attack on their own livelihoods, on their own lives. It has not escaped the notice of the harvesters that options to fence cattle or restrict the movement of cattle ranching towards the WBNP have not been discussed seriously.

4. Re-defining the Problem: The Perspective of the Local Native Communities

The major problem that Native people identify in bison management is the lack of local Native control over local bison resources.

The term, "wildlife management", may first bring to mind ideas about biological concepts and techniques, but it is also a political concept involving ideas about

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"rights to resources and the means by which such rights are defined, transmitted, contested and enforced."[8]

The historical review of bison management presented in the Diseased Bison Task Force report is a review of a series of definitions of biological problems and the applications of technology to resolve them. This review doesn't reflect the political process whereby the Canadian state has taken away many local rights over the harvesting and management of bison. In 1894 a law forbidding the harvesting of northern bison was passed.[9] In 1899, Treaty 8 containing guarantees that the people would be able to hunt, fish and trap as they had always done was signed. Despite these assurances, the ban on harvesting bison continued and in 1922 in further violation of the Treaty agreement Wood Buffalo National Park was established. Today, elders emphasize the importance of the enduring agreement between the Treaty 8 nations and the Canadian state.

The harvest of the northern bison was first regulated by law due to concern over low bison population numbers. However, when the Wainwright herd was introduced and low bison populations were no longer a concern, the people were still not permitted to hunt bison. Today, harvesting bison in the Park is illegal but next year or the year after maybe all the Park bison will be killed to make way for the wood bison. Local people comment on the basic deceit in this situation and conclude that the goal of this management process, perhaps once one of conservation, now appears to be simply about control.

Local people assert that for their own economic and social stability, they need to have control over local resources. They cannot plan for the future if they are constantly in reaction to decisions and policies made by outside agencies. The state has committed itself to this principle. Aboriginal rights are to be translated into processes designed to sustain aboriginal communities and cultures. Aboriginal rights in wildlife, in particular, are to be translated into meaningful management roles."[10]

The local people's claim to a meaningful role in bison management is based on their traditional use and management of the bison. Despite interruption over the past century in the use and management by local people of bison, there exists locally a body of knowledge about the land and the bison. This body of knowledge, based on long experience, is a sufficient database from which to develop plans to manage bison for local needs.

Most of the Native communities involved in this debate have very definite ideas about how they would like to manage the bison available to them in their geographical area. For some communities, these local bison are wood bison; for others, they are hybrid bison. For some communities, the desired goal is the maintenance of subsistence hunting; for others it is a combination of subsistence hunting and more commercialized operations of outfitting or meat production. Some communities feel that a free roaming herd best meets their needs; others see a ranch operation as best meeting their needs. In the case of a herd and a

geographical area which are used by more than one community, compromises in the goals and strategies of management are recognized as necessary.

The communities have been working towards their goals since long before this review began and they will continue to work towards their goals long after the review is completed. Band leaders emphasize the need for long-range planning, not just for the next five years or ten years, but for the next generations. What does this issue and this environmental review mean to these efforts? Is this the beginning of another major thrust of agriculture in the North at the expense of wildlife and at the expense of economies based on wildlife? Is the panel review trying to sell us on a solution which has already been decided upon? To what extent might we have to compromise on this issue to achieve these goals? Is compromise on this issue the only way in which we will be able to achieve our goals? These are just some of the questions long-range planners for these communities ask themselves.

The Panel makes its final report in March of 1990, nearly one hundred years after the imposition of the law forbidding the hunting of the northern bison. Will this final report address this outstanding management issue?.

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5. Summary

The intent of this preliminary report is to summarize Native concerns and perspectives about the proposals arising from the Diseased Bison Task Force's definition of the WBNP area bison as a problem.

The position of the Native communities states that:

a) the problem as defined by the Task Force report is greatly overstated; and

b) the real problem in bison management is the lack of Native control at the local level over local resources.

The critique developed by Native people of the Task Force's definition of the problem focuses on a number of specific points:

a) the incidence of disease
b) the validity of this approach to the genetic integrity issue
c) the risk to the health of the harvesters
d) the risk of contact between the WBNP area bison and other herds of cattle and/or wood bison
e) the issue of whether the focus on the hybrid herd adequately addresses the problem and
f) the feasibility of the wood bison substitution option.

The definition of lack of local control over local resources as the major problem in bison management is based upon a claim to superior knowledge about many aspects of local bison ecology as well as a claim to a political right based upon aboriginal rights and current economic needs.

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1. Bison Disease Task Force. 1988. Evaluation of Brucellosis and Tuberculosis in Bison in Northern Canada.

2. Federal Environmental Assessment Review Office. 1989. Northern Diseased Bison Environmental Panel. Operational Procedures. Page 1.

3. Jim Webb, personal communication, October 5, 1989. Mr. Jim Webb is the Tribal Administrator of the Little Red River Band.

4. This function is also served by the paper, "Diseased Bison in Wood Buffalo National Park. An Aboriginal Perspective" prepared for Fort Smith aboriginal groups by Martha Johnson, Research Director of the Dene Cultural Institute in co-operation with Dr. Fikret Berkes of the Department of Environmental Studies of Brock University. This paper focuses on the Fort Smith community alone but the main points it makes overlap markedly with the points presented in this

report. Since Johnson and Berkes's paper arrived as this report was on the point of being mailed, I have not attempted to integrate it other than through this footnote. The Dene Cultural Institute paper is available through the Panel Secretary.

5. eg. Laviolette, Frank nd. Needle Lake - Providence Wood Bison Transplant Report.

6. eg. Feit, H.A. 1986. James Bay Cree Indian Management and Moral Considerations of Fur-Bearers. In. Native People and Renewable Resource Management, the 1986 Symposium of the ALberta Society of Professional Biologists.

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8. Hunn, E.S. and Williams, N.M. 1982. "Introduction". In Williams, N.M. and Hunn, E.S.. Resource Managers: North American and Australian Hunter-Gatherers. AAS Symposium. #67. Colorado: Westview Press.

9. Statutes of Canada. Chapter 31, 57 - 58 VIC
   "Act for the preservation of game in the unorganized part of the North-west Territories of Canada."

10. DIAND (Department of Indian Affairs and Northern Development). 1981. In all Fairness: A Native Claims Policy. Ottawa: Queen's Printer.

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APPENDIX A

Statement of Work

The contractor is to provide advice to the Northern Diseased Bison Environmental Assessment Panel and other participants in the Panel review on issues relating to the traditional role of bison in native culture in and around Wood Buffalo National Park. This advice is to be provided on an as required basis and need not be limited to the following:

1. Reviewing material supplied by the Panel on the Northern Diseased Bison review relating to native views and concerns.

2. Meeting with the Panel and Panel Secretariat to identify and discuss issues, identify information gaps and provide specialist insight into concerns relating to impacts on native communities from the short and long term manipulation of bison populations.

3. Meeting with review participants such as public interest groups, native organizations and government agencies as requested and approved by the Panel Secretariat, to provide specialized advice on and clarification of issues relating to general information requirements and bison importance to native people.

4. Attending public meeting and hearings held by the Panel.

5. Providing the Panel with a written public report on specific issues related to the importance of bison to native people.

6. Assisting the Panel with the preparation of its final report to Ministers.

APPENDIX B

Schedule of Meetings with Community Representative

Aug. 8	Ron Loonskin, Councillor and Band Representative for Bison Management Issue.
Aug 10	Jim Thom, Mike Thom, Bob Head, James Christie, Art Look, Michael Macleod representing between them the Dene Band, the Metis Association, the HTA and the Denendeh Conservation Board, Fort Providence.
Aug. 16	Harvey Bulldog, Chief and Manager of Boyer River Farms, Boyer River Band.
Aug. 31	Daniel Sonfrere, Elder, Group Trapping Area Leader, Hay River, NWT
Sept. 1	Roy Fabien, Chief, Hay River Dene Band.
Sept. 4	Frank Laviolette, Elder and Bison Harvester, Park-user, and David King, Elder, Fort Smith.
Sept. 5	Henry Beaver, Chief of Fort Smith Band, Raymond Beaver, Band Member, Frank Laviolette, Ken Hudson, President, HTA, Fort Smith
Sept. 6	Chief Sayine, Council and interested observers, Fort Resolution.
Sept. 11	Harvey Denechoan, Hay Zama Wood Bison Project, Dene Th'a Tribal Administration (Phone conversation).
Sept. 13	Sonny Flett (WBNP Wildlife Advisory Board, Metis Association), Archie Waquan (Park Harvester), Fort Chipewyan.
Sept. 14	Matthew Lepine (Cree Band Chief) Edward Lepine (Cree Band Councillor). Andrew Campbell (Park-user; Bison-harvester), Pat Marcel (Chief of Chipewyan Band), all above in Fort Chipewyan.

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REPORT TO THE NORTHERN DISEASED BISON ENVIRONMENTAL REVIEW PANEL ON BISON GENETICS

BY

R. T. BERG, PH.D.

TECHNICAL SPECIALIST

THE SITUATION

The bison population occupying Wood Buffalo National Park and its surrounding areas, numbering approximately 4000 head, is mostly hybrids, a mix of plains and wood bison, and approximately 50% is infected with either bovine tuberculosis or brucellosis. In the early 1960's a remnant herd of wood bison was identified in the northern part of the park which was judged to be pure wood bison. A wood bison recovery and conservation program was initiated by capture and transfer of wood bison from the remnant population to establish two new populations - the Mackenzie Bison Sanctuary (MBS), northwest of Great Slave Lake, and Elk Island National Park (EINP) in Alberta.

The founding populations were 6 males and 12 females transferred to MBS in 1963 and 4 males and 17 females transferred to EINP in 1965. Further transfers (all from EINP) have taken place to other bison sanctuaries, zoos and wildlife parks since 1976 (Table 1). The recovery program has resulted in an estimated number of pure wood bison of 2342 in 1987. With a probable 10-15% increase in the last two years, the numbers of pure wood bison would exceed 2500 head. The majority of these wood bison are in six publicly managed populations with about 75% in MBS and 10% in EINP (Table 1).

GENETIC UNIQUENESS OF THE WOOD BISON (*Bison bison athabascae*)

There is general, though not unanimous agreement, that the recovered wood bison population is representative of the historical wood bison subspecies (*Bison bison athabascae*) with a minimum of introgression of genes from the plains bison (*Bison bison bison*) (Gates, 1987). The two subspecies are distinguished by phenotypic (morphological)

TABLE 1. THE 1987 STATUS OF WOOD BISON DERIVED FROM BISON CAPTURED IN WOOD BUFFALO NATIONAL PARK IN 1963 AND 1965.

Herd Type and Location	Transfer Year	Source	Number Transferred			Number Fall 1987
			M	F	T	
Mackenzie Bison Sanctuary	1963	WBNP	6	12	18	1718
Elk Island National Park	1965	WBNP	4	17	21	256
Nahanni-Liard River, NWT	1980	EINP	12	16	28	30
Hay-Zama, AB	1984	EINP	15	14	29	43
Nisling River, Yk	1986	EINP	15	19	34	45
Waterhen, Man.	1984	EINP	16	18	34	106
7 Canadian Zoos & Wildlife Parks	1976-81	EINP	28	26	54	144
Munich Zoo, FRG	1981	EINP	2	3	5	9
				Total		2342

From: Status Report on Wood Bison in Canada 1987.
Prepared by: The Wood Bison Recovery Team, Dr. C. Gates (Chairman), Northwest Territories Wildlife Service, Fort Smith, NWT.

differences with wood bison being larger in body size, having larger horn cores, darker pelage, lack of hair on their upper forelegs (chaps) and smaller beards. A multivariate morphometric model was developed by van Zyll de Jong (1986) to distinguish members of the two subspecies.

Attempts to find genetic markers which might be useful for distinguishing members of the two subspecies and their hybrids have to date been unsuccessful. Bloodtyping (Zamora, 1983), karyotyping (Ying and Peden, 1977) and DNA studies (Bork and Salmon, 1989) have not resulted in discovery of subspecies uniqueness. The identification of unique DNA sequences is proposed as a possible genetic test for subspecies identification (Salmon, 1989) but no useful techniques can be expected for at least several years.

GENETIC CONCERNS RELATED TO WOOD BISON CONSERVATION

A genetic concern related to wood bison recovery is whether the recovered populations have enough genetic variation to assure their viability and survival as a distinct subspecies. The recovered wood bison population (Table 1) has recently gone through a genetic bottleneck; the numbers were much reduced and the present herds came from a very small population of foundation animals (18 for Mackenzie Bison Sanctuary and 21 for Elk Island National Park and all its derivatives, Table 1). The bottlenecking process reduces available genetic variation and leads to inbreeding which can reduce the viability and chance for survival of a species. Recovery and viability of bottlenecked populations depends on achieving adequate population numbers which allows accumulation of genetic mutations

and recombinations, restoring genetic variation to the population. The present recovered wood bison population has exceeded the critical population size demonstrating sufficient genetic variation to assure viability and survival. There still remains some concern in that, of the recovery populations, only two have reached the numbers where they can be considered viable (Mackenzie Bison Sanctuary and Elk Island National Park). With only two populations classified as viable there remains a risk that some natural or other catastrophy could render one or the other of the two herds inviable (eg. disease, genetic contamination, loss of habitat or other natural disasters). It is therefore urgent that steps should be taken to assure that at least two more geographically distinct populations be increased to a minimum of 200 head as soon as possible.

GENETIC INTEGRITY OF WOOD BISON

The primary objective of the environmental review process is "controlling or eliminating the bison disease problem in and around Wood Buffalo National Park (WBNP)". A second objective is "the preservation of WBNP bison as the world's largest free roaming, naturally-regulated herd of bison". Strong support has been advanced, particularly by the Government of the Northwest Territories (1989) that the subspecies of wood bison (Bison bison athabascae) should be restored to its traditional range and that hybrids and plains bison should be removed. The genetic reality is that a distinct wood bison species can not be maintained in the presence of hybrids or plains bison

because of the uninhibited crossing that freely occurs.

Maintaining genetic integrity of recovered wood bison populations is closely linked to the disease irradication problem since the greatest risk of genetic contamination comes from the same hybrid diseased WBNP population of bison. If the diseased hybrid bison are removed the risk of genetic contamination will also be greatly reduced. There is some risk of genetic contamination from plains bison which might be in the proximity of the wood bison range (eg. on ranches).

GENETIC IMPLICATIONS OF SALVAGING WOOD BISON FROM THE DISEASED HERDS

It may be that there are bison in WBNP and in the Slave River Lowlands which would be classified as wood bison. The question arises whether salvage of some of these animals would be helpful to the conservation of the wood bison subspecies. The concerns relate to conservation and genetic diversity discussed earlier. As mentioned, viability of the recovered wood bison population is indicated by the population reaching critical numbers after passing through a genetic bottleneck. The wood bison of the Mackenzie Bison Sanctuary, numbering about 2000 are well past the critical numbers assuring their viability. The bison in Elk Island National Park, numbering 250 also can be classified as a viable population. It is important to establish other viable herds (greater than 200 head each) to minimize the risk of loss of any of the recovered populations and the negative effect such a loss would have on the whole recovery program.

If positive action is taken to establish additional viable herds of wood bison (or to raise those in process to a viable number of 200), there should be no concern about sufficient genetic variation in the recovered wood bison to assure success of the recovery and conservation program.

It is true that additional genetic variation would generally be beneficial to a species conservation program. However, since the recovered populations have already passed the critical numbers, assuring viability, the need for additional genetic variation is not critical. Also there are no genetic tests available at the present time to assess how closely related any salvaged wood bison might be to the recovered wood bison populations.

Salvage might be beneficial if it resulted in a more rapid increase in population numbers in the herds being raised above critical status. However, because of the difficulties related to disease control, and genetic classification, the operational difficulties and cost of salvage operations, and its minimal potential genetic benefit, salvage can not be considered a priority strategy.

RECOMMENDATIONS RELATING TO THE GENETIC INTEGRITY AND CONSERVATION OF THE WOOD BISON SUBSPECIES

(1) A strategy should be developed which protects the existing wood bison recovery herds from contact with hybrid or plains bison. This is particularly critical for the Mackenzie Bison Sanctuary population.

(2) Continued expansion of wood bison numbers in the Mackenzie Bison Sanctuary and in Elk Island National Park should be a high priority.

(3) Numbers should be increased in the remaining wood bison recovery herds with the objective of having at least two more with 200 head each.

(4) Salvage of wood bison from the diseased herds of Wood Buffalo National Park or the Slave River Lowlands is not considered necessary.

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EFFECTS OF BISON POPULATION CHANGES ON WOLF-PREY DYNAMICS IN AND AROUND WOOD BUFFALO NATIONAL PARK

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and

Northern Diseased Bison Environmental Assessment Panel

5 October 1989

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ABSTRACT

(1) Various agencies have expressed concerns over the possible effects of a bison depopulation programme in and around Wood Buffalo National Park (WBNP) on existing predator-prey systems. The present document summarizes the information available on the subject and the conclusions drawn from such review.

(2) The bison population in WBNP declined during the last two decades, following the adoption of a non-interference management policy by the administration of the Park. Natural levels of wolf predation and the presence of brucellosis and tuberculosis were associated with a sustained decline of the bison population. Bison were subject to natural perturbations (i.e., severe winters, flooding, etc), but the sustained decline of the bison could not be attributed to such factors. It is concluded that the current situation in the Park does not ensure the long-term survival of the bison population.

(3) Moose densities in forested areas (secondary bison ranges) have been low (0.1-0.2 animal$\cdot$km^{-2}) during the last decade. High calf:cow ratios in early winter suggest an adequate level of nutrition for moose and a reduced impact of wolf predation on calves. Wolves seem rare in moose ranges presumably because of the relatively low density of moose.

(4) A reduction of the bison prey base will force wolves to decline, particularly the wolf packs inhabiting primary bison ranges (i.e., 10-15% of the Park area). The number of wolves thus affected may be in the range of 75-100 animals. Absolute disappearance of the wolf from primary bison ranges is not predicted; wolf-bison relationships will develop again after the re-establishment of a healthy bison population in the Park.

(5) The wolf-moose system currently existing in forested areas should not be affected significantly by a bison depopulation programme. Furbearer species should also not be affected. However, a full recovery of the bison population following disease eradication may exacerbate the level of wolf predation on moose, assuming that the resulting higher populations of wolves can target moose disproportionately. Because of this uncertainty, it is recommended that tri-annual moose surveys be conducted during the bison depopulation-repopulation programme.

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1. INTRODUCTION

In February 1989, an Environmental Assessment Panel was created to publicly review the implications of managing a diseased and hybrid bison (Bison bison) population in and around Wood Buffalo National Park (WBNP). The panel received the mandate to review proposed courses of action to alleviate the disease and hybridization problems.

During the Issues Scoping Sessions in April 1989, various agencies expressed concerns over the effects of changes in bison abundance on existing predator-prey systems. In particular, questions were formulated with regard to the impacts of bison depopulation on wolf (Canis lupus) populations and the level of wolf predation on other prey species. In August 1989, the Panel sought the expertise of a technical specialist to review the information available regarding these issues. The present document summarizes the findings and conclusions derived from such consultation.

The terms of reference for the present review were described as follows:

> "What are the potential ecosystem impacts of bison depopulation-repopulation on the predator-prey relationships (particularly wolf-bison relationships) in the area? Compare abrupt to gradual depopulation-repopulation processes. Identify management options designed to minimize the impact of bison depopulation on other wildlife populations."

To meet the terms of reference, the report is structured in four sections:

(1) A summary of the information on past and current population status of bison, wolves, moose, and other prey species;

(2) A description of the potential effects of bison depopulation on wolf-prey dynamics;

(3) An analysis of the long-term implication of bison repopulation on wolf-prey dynamics;

(4) A list of interim measures to mitigate the negative effects of a bison depopulation-repopulation programme.

2. POPULATION STATUS

2.1 Bison.

Following the introduction of 6670 Plains bison into WBNP between 1925 and 1928, the bison population increased to 10 000-12 000 animals by 1934 (Soper 1941). During the first aerial survey conducted in 1961, a total of 10 273 bison were counted on the primary ranges. Thus, the bison population may have remained relatively stable in the 1940s, 1950s, and presumably 1960s (no other survey estimates available). Slaughters to provide meat for Roman Catholic missions and Indian people were carried out between 1935 and 1967 and in 1974 (Carbyn *et al.* 1989:16). Approximately 5380 bison were killed during the 34 years of

slaughtering operations, with an overall average kill of ≈160 animals per year.

Park personnel began conducting total-count surveys on a regular basis during the winter 1970-71. For each survey (except in 1982), an attempt was made to count all bison in the park by an extensive search of bison ranges by aircraft (see Carbyn et al. 1989:129-139 for methodology). Survey data (Fig. 1) indicated that the bison population progressively declined in the 1970s and 1980s at the average rate of 5% per year, from ≈11 000 in 1970 to ≈3250 in 1989. A sudden drop in numbers was noticed in 1975 following the mass drowning of ≈3000 animals.

The vast majority (88%; Carbyn et al. 1989:134) of bison surveyed was concentrated on the primary bison ranges (e.g., the Peace-Athabasca delta). "Primary ranges are areas that are consistently used by bison during winter and are also used to a large extent during summer... Secondary ranges receive intermittent use and are rarely frequented by large herds on a regular basis" (Carbyn et al. 1989:115). Primary ranges cover approximately 5500 km^2 (Oosenbrug and Carbyn 1985:69), leaving 39 300 km^2 as secondary ranges in WBNP (Fig. 2).

Pertinent information on calf counts was gathered in 1985-89 (Table 1). Shortly after the calving season, the ratio of calves to females (≥ 2 years of age) ranged from 0.22 to 0.32 during this 5-year period. Carbyn et al. (1989:179) proposed a correction factor of 10 calves per 100 females to account for calves that were either lost to predators or unborn at the time

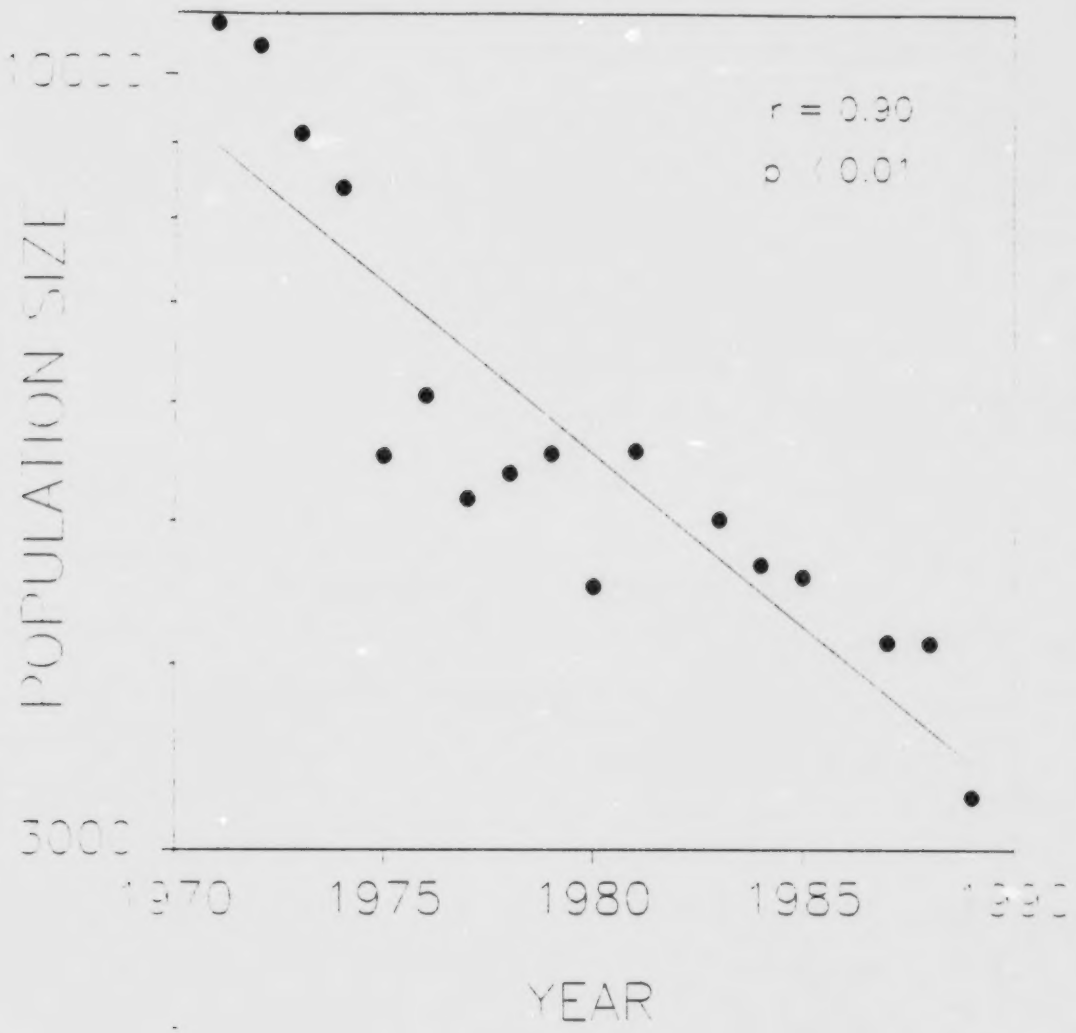

Figure 1. Population changes of bison in Wood Buffalo National Park, 1970-1989 (Carbyn et al. 1989). The regression line is $Y = 9454\ e^{-0.053(x)}$, where Y represents the population size and x the number of years span since 1970. Population projections for years 1995 and 2000 are 2488 and 1905 bison, respectively.

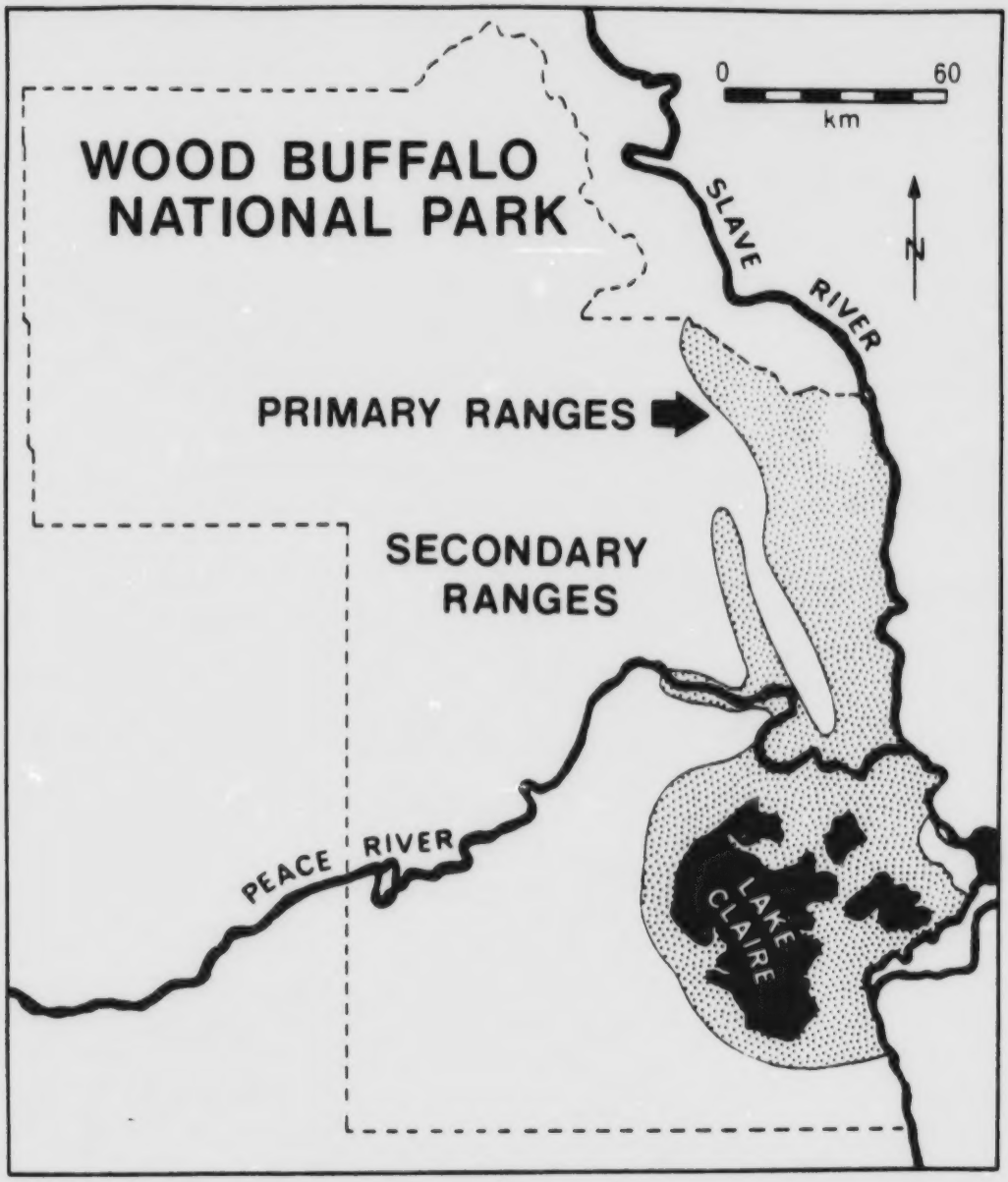

Figure 2. Current distribution of primary and secondary bison ranges in Wood Buffalo National Park (Carbyn et al. 1989:116).

Table 1. Post-parturition classified counts of bison obtained from the Peace-Athabasca delta area, 1985-89 (from Carbyn et al. 1989:180).

Year	N[a]	Ratio calves :adult females[b]	Ratio yearlings :adult females[b]
1985	1099	0.28	0.27
1986	2171	0.32	0.21
1987	1845	0.30	0.19
1988	1914	0.25	0.09
1989	1365	0.22	0.04

[a] excluding males ≥ 2 years of age.

[b] females ≥ 2 years of age.

of the surveys. Considering this correction factor, estimates of calf production would range from 32 to 42 calves per 100 females.

Data on herd segregation counts indicated a recent decline of yearling recruitment, from 0.27 yearling per adult female in 1985 to 0.04 in 1989 (Table 1). Low recruitment of yearlings would imply that calves survived poorly during their first year of life. Assuming a balanced sex ratio, population stability could be maintained if the yearling:female ratio is at least twice the annual mortality rate of adult females. For example, a mortality rate of 10% for adult females (see Oosenbrug and Carbyn 1985:227) would require a yearling:female ratio of at least 0.20 to ensure population stability. Therefore, low recruitment of yearlings in recent years probably forced the bison population to further decline (Fig. 1).

2.2 Wolves.

Carbyn et al. (1989:32-36) summarized the information on wolf abundance in and around WBNP for the period 1920-1981. Wolves apparently expanded in numbers from 1920 to 1935. The increase in wolf abundance prompted buffalo rangers to initiate a poisoning programme sometime after 1935 (exact date unknown). Predator control continued at various levels of intensity until the 1960s. The number of wolves killed during the programme was not documented precisely, but believed to be in the range of 20-100 per year (Carbyn et al. 1989:35). During the eight years in

which more complete information was available (i.e., 1945-46, 1948-49, 1951-54, 1957-60), the annual harvest of wolves ranged from 19 to 83 and averaged 46 animals. Wolf control was particularly intense during the 3-year period between 1951 and 1953, with a total of 186 wolves removed. The number of wolves poisoned, but not retrieved, is not known and would have the effect of inflating the above figures.

Data on fur harvest (Fig. 3) tended to indicate that the wolf population remained low during the 1950s, particularly during the period of intense wolf control. From 1960 to 1975, records of fur harvest suggested that wolves expanded in numbers (Fig. 3). It is believed that the wolf population peaked around 1975, some 5-10 years after termination of the poisoning programme (Oosenbrug and Carbyn 1985; Fig. 3).

Two lines of evidence suggested that the wolf population declined late in the 1970s and during the 1980s. First, sightings of wolves during bison surveys decreased during that period (Table 2). Second, the average group size of wolves also declined (Table 2). Other studies have shown that average pack size of wolves is closely related to wolf abundance (Rausch 1967; Mech 1977; Messier 1985a).

The impact of human-induced mortality was probably light to moderate during the recent wolf decline. The harvest of wolves by trappers averaged only 12 animals per year during the period 1976-1988 (Milne 1989). In addition, Oosenbrug and Carbyn (1985:117-119) reported that human-induced mortality of radio-

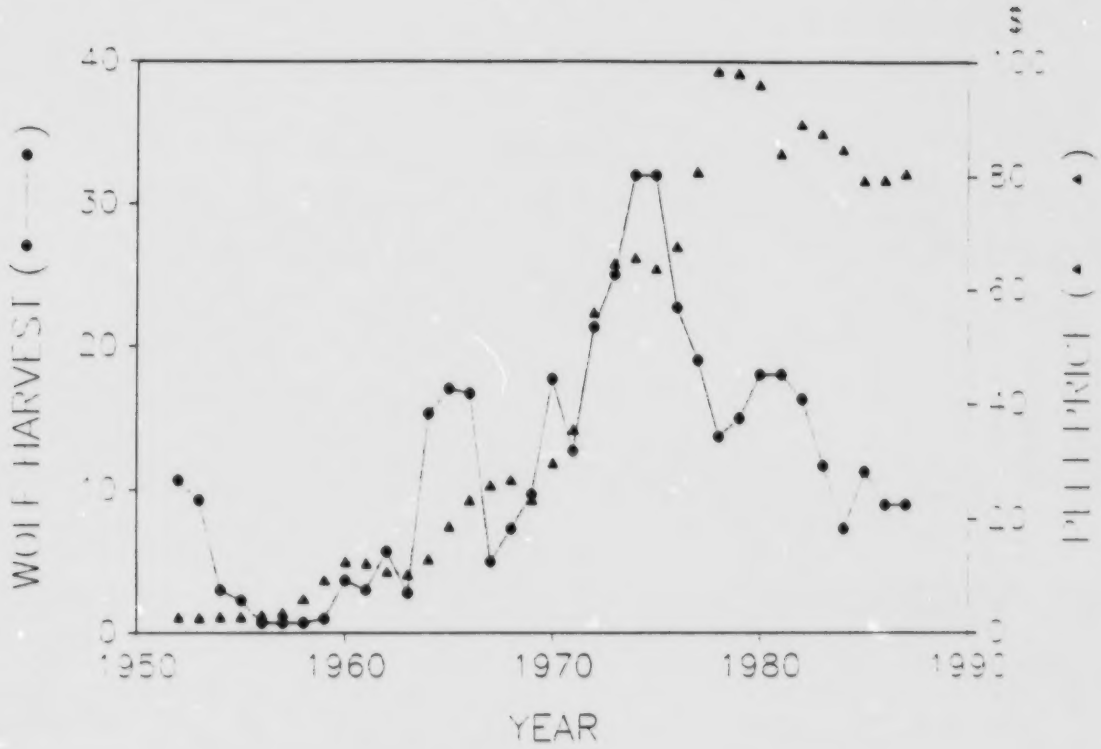

Figure 3. Trends (i.e., 3-year moving averages) in the number of wolves harvested for fur in Wood Buffalo National Park from 1950 to 1988. Changes in the average pelt price are also presented to facilitate the interpretation of data.

Table 2. Changes in the number of wolves sighted per hour, and the average group size of wolves, during regular aerial surveys of primary bison ranges in Wood Buffalo National Park, 1970-1989 (Oosenbrug and Carbyn 1985:51; Park Warden Service files). Missing years are those with less than five groups of wolves observed.

Year	Hours flown	No. wolves sighted	No. wolves/ hour flown	Mean wolf group size
1970-71	??	158	??	9.3
1971-72	??	317	??	9.6
1972-73	140	447	3.2	10.1
1973-74	99	361	3.7	14.5
1974-75	94	165	1.8	8.1
1975-76	63	54	1.9	6.0
1976-77	77	103	2.3	7.6
1977-78	64	31	0.5	7.7
1978-79	55	36	0.7	6.0
1980-81	28	18	0.6	5.3
1986-87	35	41	1.2	6.8
1987-88	29	33	1.1	6.6
1988-89	37	84	2.3	7.0

collared wolves in WBNP never exceeded 10% per year during their 3-year study (1977-1980). Keith (1983) and Peterson et al. (1984) estimated that wolves can sustain a death rate of ~30% per year without experiencing a population decline.

The number of wolves inhabiting the primary bison ranges in WBNP was estimated at 136 in the winter of 1977-78 (Oosenbrug and Carbyn 1985:69). The current population of wolves in this region is not known and may be approximated to be 75-100 animals given the apparent wolf decline since 1975 (Table 2). A total of 84 wolves was observed during a survey in March 1989 (Huisman 1989), although multiple counts of wolves may have occurred during this survey.

2.3 Moose.

Only two moose (Alces alces) surveys have been completed in WBNP and both covered a fraction of the Park. The first (Resource conservation 1981), conducted in the winter of 1980-81, revealed a moose density of 0.17 animal $\cdot$ km^{-2} ($\pm$ 42%, α = 0.05), a calf:female ($\geq$ 1 year of age) ratio of 0.68, and a male:female ratio of one. The second (Morgan 1989), conducted in the winter of 1987-88, yielded a moose density of 0.12 animal $\cdot$ km^{-2} ($\pm$ 38-100%, α = 0.05), and a calf:female ratio of 0.62 (assuming a male:female ratio of one as in 1980-81).

Personnel of the N.W.T. government carried out moose surveys in the Slave River Lowlands (SRL), with results comparable to those conducted in the WBNP. In SRL, moose densities in 1986-88 ranged from 0.14 to 0.21 animal·km^{-2} and the ratio of calves to females varied from 0.67 to 0.73 (R. Graf, G.N.W.T., pers. comm., August 8, 1989).

2.4 Other prey species.

Three other prey species are exploited to some extent by wolves in WBNP (Oosenbrug and Carbyn 1985): i.e., beaver (Castor canadensis), muskrat (Ondatra zibethica), and snowshoe hare (Lepus americanus). The low occurrence (11%) of beaver hair in wolf scat (Oosenbrug and Carbyn 1985:220), and the limited number of beaver captured by trappers (mean = 157 animals per year, 1980-88; Milne 1989), suggest a low density of beaver. Muskrats are known to be particularly abundant in the Peace-Athabasca delta (Milne 1989). The population status of snowshoe hare is unknown. It is assumed that snowshoe hares are subject to wide fluctuations in numbers over the years.

2.5 Predator-prey systems.

Operationally, WBNP can be portrayed as two predator-prey systems. In the primary bison ranges (Fig. 2), the wolf population depends heavily on the availability of bison

(Oosenbrug and Carbyn 1985). In 1989, approximately 2900 bison (i.e., 88% of 3250 animals) were using the primary ranges, compared to a maximum of 800 moose (i.e., 5500 km^2 X ≈0.15 moose·km^{-2}, which is the average moose density in the Park). The figure of 800 moose is considered high because primary bison ranges are poor moose habitats. In comparison, about 420 bison (i.e., 12% of 3250 animals) used secondary bison ranges intermittently in 1989. For moose, there were roughly 5900 animals (39 300 km^2 X ≈0.15 moose·km^{-2}) using the same ranges. Assuming that these figures are close to reality, bison are four times more numerous than moose in primary bison ranges, whereas moose are fourteen times more numerous than bison in secondary bison ranges. Therefore, the primary bison ranges can be described as a wolf-bison system, and the secondary bison ranges, which are more forested, as a wolf-moose system.

2.6 Overview.

In the 1960's, the administration of WBNP adopted a non-interference management policy with the termination of commercial bison culling and wolf control programmes. In the ensuing two decades, the number of bison gradually declined. The exact causes that led to this decline are difficult to establish in retrospect, although some inferences can be proposed based on the current information.

Bison in WBNP, like all animals, are subject to natural perturbations. Variation in rainfall, temperature, and snow accumulation may affect the demography of bison, sometimes negatively, but other times positively (Carbyn et al. 1989:75-102). In a similar way, bison are at risk of drowning when they cross rivers and lakes during their seasonal movements. In some years, like 1974, mortality from drowning is more pronounced than others. Environmental influences like these inevitably induce natural variation in the population parameters of bison. However, they can not explain a persistent decline in numbers over two decades.

Possible causes of the failure of the bison population to increase can be inferred by comparing the disease-free bison populations in Elk Island National Park (EINP; The Wood Bison Recovery Team 1987) and the Mackenzie Bison Sanctuary (MBS; Gates and Larter 1989), with the diseased bison populations in WBNP (Carbyn et al. 1989) and SRL (Van Camp and Calef (1987). The EINP and MBS bison populations grew at an average rate of 24-26% per year (Table 3) during periods with no human hunting. In contrast, the WBNP population declined by ~5% per year with some human hunting (1-2% per year, outside the park) and the SRL population decreased at a rate of 17% per year (Fig. 4) with a hunting rate of 4-10% per year (i.e., a net rate of decrease of ~7% per year if the effect of hunting is discounted). The situation in the SRL represents an ecological replicate of the WBNP. In both cases, natural levels of wolf predation and the presence of brucellosis

Table 3. Comparisons of population dynamics of wood bison in Elk Island National Park (EINP, 1971-1983), Mackenzie Bison Sanctuary (MBS, 1964-1987), Wood Buffalo National Park (WBNP, 1971-1989), and Slave River lowlands (SRL, 1974-1982). Data were extracted from the reports of Calef (1984), Reynolds and Hawley (1987), Gates and Larter (1989), and The Wood Bison Recovery Team (1987).

Parameters	EINP	MBS	WBNP	SRL
Average rate of growth (% total pop. per yr)	26	24	-5	-17
Pregnancy rate (% ♀♀ ≥ 2 yr of age)	61-82	70	(46)[a]	N.A.[b]
Calf production (% total pop. in Jun-Jul)	N.A.	22	11-17	17
Recruitment of yearlings (% total pop. ≥ 1 yr of age)	N.A.	15	3-13	4
Percent annual hunting	0	0	<1-2	4-10
Predation by wolves	Absent	Rare	Normal	Normal
Presence of brucellosis	No	No	Yes	Yes
Presence of tuberculosis	No	No	Yes	Yes

[a] average pregnancy rate (N = 1802) as reported in 9 years of slaughter data (Fuller 1962: Tessaro 1987:67).

[b] N.A. = not available.

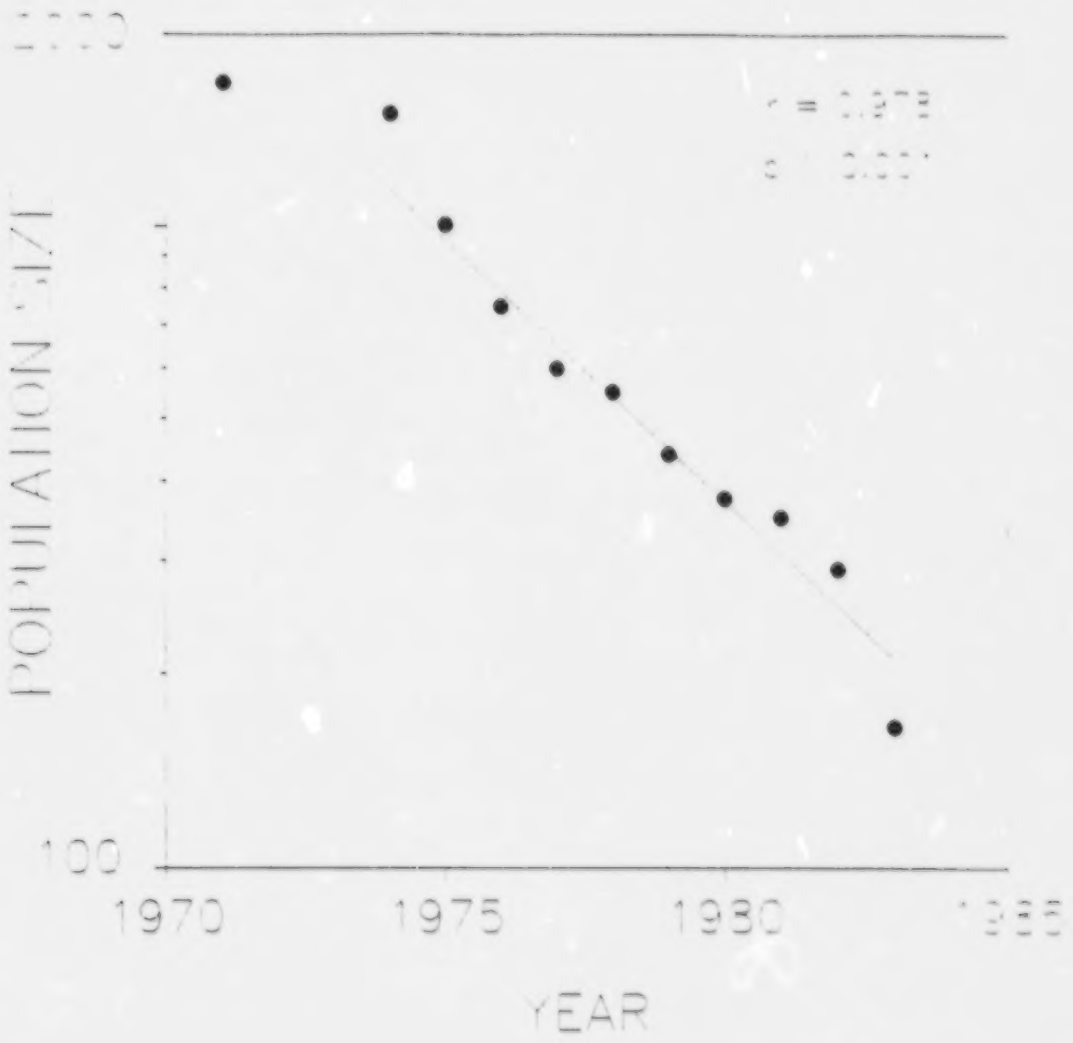

Figure 4. Population changes of bison in Slave River Lowlands, 1970-1989 (Van Camp and Calef 1987). The regression line is $Y = 2460\ e^{-0.189(x)}$, where Y represents the population size and x the number of years span since 1970.

and tuberculosis were associated with a sustained decline of the bison population.

Various relationships may be implicated in the negative effects of diseases and wolf predation on bison. First, brucellosis is known to depress the reproductive potential of bison (Tessaro 1987:66-71). In 1952-74, the average pregnancy rate of adult female bison in WBNP was only 46%, as compared to 61-82% for disease-free populations (Table 3; Reynold et al. 1982). Tessaro (1987) reported a pregnancy rate of 33% (N = 27) in a sample of bison from WBNP and SRL in 1983-85. Data on calf:cow ratios (Table 1) also suggested low reproductive performance. Second, infections with tuberculosis and, to some extent, brucellosis are frequently associated with debilitating lesions (e.g., arthritis; Tessaro 1987) that may reduce the life expectancy of infected animals and, consequently, their life-time reproductive success. Third, debilitated bison seem to be more vulnerable to wolf predation. The net effect is likely a higher than normal killing rate of bison by wolves. High killing rates in turn would favour an increase in wolf abundance. In my view, the synergetic effect of diseases and wolf predation seems to represent the best explanation for the sustained decline of bison numbers in WBNP and SRL during the last two decades.

How low must the WBNP bison population be before wolf predation diminishes sufficiently to ensure population stability? No information exits to answer this question. The ten-fold decrease of the SRL bison population (Van Camp and Calef

1987) would suggest a strong resilience of wolf predation to declining bison numbers. The gregarious nature of bison may explain such resilience, as a decline in numbers is not necessarily associated with a corresponding decline in the degree of contact with the prey.

The apparent resilience of wolf predation to declining bison numbers does not imply that the wolf population is not affected by changes in bison abundance. In fact, there is some indication that wolves in the primary bison ranges have declined since 1975, presumably because of lower bison numbers. Other studies have shown that the availability of ungulates determine the density of wolves (Mech 1977; Keith 1983; Messier 1985a; Peterson and Page 1988). Consequently, it is assumed that the number of wolves inhabiting primary bison ranges declined proportionally to the decline in bison numbers.

No study has evaluated the impact of wolves on moose in and around WBNP. However, the high ratios of calves to adult females reported in recent surveys suggest that the impact of wolf predation on moose is minimal. A calf:female ratio greater than 0.60 in early winter is typical of moose populations with no or limited wolf predation (Blood 1973; Rolley and Keith 1980). For example, Messier and Crête (1985) reported ratios of calves to adult females of 0.65, 0.41, and 0.37 for moose populations subject to wolf predation rates of 6, 11, and 19% per year, respectively. The reduced impact of wolf predation on the moose population inhabiting WBNP may be related to the relatively low

abundance of moose (0.1-0.2 animal·km^{-2}). Messier (1987) has presented empirical evidence that wolves were nutritionally stressed, and rare, when moose density dropped below 0.2 animal·km^{-2}.

3. EFFECTS OF BISON DEPOPULATION.

In the present analysis, it is assumed that the majority of bison in and around WBNP will be eliminated during a 3-year period. If the period of bison depopulation is more prolonged (e.g., 5-7 years), the overall effects of lower bison numbers on wolves are expected to be similar to those described below.

3.1 Effects on wolves.

Any reduction of the bison prey base will have subsequent repercussions on the wolf population inhabiting primary bison ranges. The number of wolves that will be subject to nutritional stress can be approximated to be 75-100 animals in WBNP and 15-20 animals in SRL. The reduction of wolves should be proportional to the fraction of the bison population culled each year. Recent studies have shown the direct relationship between wolf density and the availability of ungulates (Mech 1977; Messier and Crête 1985; Peterson and Page 1988). However, absolute disappearance of the wolf from primary bison ranges is not expected. A lower wolf population will probably subsist on

moose found in riparian habitats. Furthermore, wolf-bison relationships are likely to develop again once bison are re-established in the Park.

A shortage of food generally causes growth retardation in wolf pups and a general reduction in the number that survive (Van Ballenberghe and Mech 1975; Messier 1987). Adult wolves, because of their higher social status, are less affected by a reduction of the prey base (Mech 1977). Therefore, the reduction in wolves, as a result of bison depopulation, would be caused primarily by poor survival of pups and, secondarily, by lower survival of adult wolves. It is expected that the adjustment of wolf numbers to bison culling will be progressive and with a relatively short time-delay (< 1 year).

The depopulation of bison will have repercussions on the social organization of wolves. In particular, it is predicted that pack dissociation and extra-territorial movements will be more frequent. Recent studies have established that a reduction of ungulate density increases the tendency of yearling and adult wolves to live solitarily and to make excursions outside their home territories (Peterson et al. 1984; Messier 1985b). It is also expected that the occurrence of extra-territorial forays of wolf packs will occasion lethal strifes among wolves (Mech 1977; Peterson and Page 1988). Inter-pack aggression represents an additional mechanism that will force wolves to adjust their numbers to a lower prey base.

The effects of bison depopulation on wolves inhabiting secondary bison ranges are more difficult to predict. There, wolf density is already low due to low numbers of moose and an intermittent use of these ranges by bison. Consequently, secondary bison ranges (Fig. 2) could not accommodate higher numbers of wolves in on a sustainable basis, independent of the situation prevailing in the primary bison ranges during the depopulation phase. This author believes that the current low abundance of moose in secondary bison ranges would not permit a colonization of wolves originating from primary bison ranges.

3.2 Effects on moose.

As already mentioned, the current impact of wolf predation on moose seems limited. Estimates of calf:cow ratios in WBNP and SRL are typical of moose populations with adequate nutrition and high survival of calves.

An area of uncertainty can be identified in regard to potential negative effect of bison depopulation on moose. It can be hypothesized that a reduction of bison would displace wolves toward secondary bison ranges and would exacerbate predation on moose. However, as explained above, my assessment is that a reduction of bison prey base will have little impact on moose population dynamics. The situation in the SRL provides excellent evidence in that regard. There, bison numbers declined ten-fold

during the last two decades and the survival of moose calves remained exceptionally high (i.e., 0.67-0.73 calf per adult female), suggesting low levels of predation. The negative relationship between wolf predation and calf:cow ratio in early winter is well documented for moose (Gasaway et al. 1983; Messier and Crête 1985).

3.3 Other effects.

No obvious effects of bison depopulation can be predicted on other prey species such as beaver, muskrat, and snowshoe hare. It is unknown whether lower wolf numbers would be beneficial to them.

There is no indication that culling of bison will exacerbate the taking of furbearer animals caught in traps by wolves. The author recognizes, however, that wolves may scavenge lynxes secured in traps for an extended period of time. It is predicted that the frequency of such incidents will remain roughly unchanged.

4. EFFECTS OF BISON REPOPULATION

4.1 Effects on wolves.

The re-establishment of a healthy bison population in WBNP will favour a rapid recolonization of primary bison ranges by wolves. The number of wolves that may be expected after bison repopulation will be proportional to the size of the bison herd. Assuming an increase of bison to levels observed in the 1960s (10 000 - 12 000 animals), a total of 150-250 wolves would probably occupy primary bison ranges. An increase of wolves in the SRL is also expected.

The ratio of wolves to bison should remain lower after bison repopulation, than before depopulation. The eradication of brucellosis and tuberculosis in bison should improve their physical condition and should reduce their vulnerability to wolf predation. A decrease of bison vulnerability to wolf predation may change the natural balance between bison and wolf numbers, in favour of the bison.

4.2 Effects on moose.

The full implication of a bison recovery for the moose population is difficult to predict at this time. There is a possibility that higher levels of wolf predation, because of a greater abundance of wolves, may affect moose numbers. It is

predicted that as bison increase in numbers, they will use secondary bison ranges more extensively. This encroachment of bison on the moose ranges (secondary bison ranges) may favour an increase of wolves in these areas. It is possible that an expanded wolf population in forested areas, because of a greater abundance of bison, will target moose disproportionately. Gates and Larter (1989) have discussed the interrelationships among wood bison, wolves, and moose in the Mackenzie Bison Sanctuary. These authors have linked the current rarity of moose in this region to a recent expansion of the wood bison and a greater density of wolves.

4.3 Other effects.

The effects of bison repopulation on other prey species should be minimal. It is generally assumed that wolves have a limited impact on alternative prey species such as beaver, muskrat, and snowshoe hare.

5. INTERIM MEASURES

Various management options can be considered to minimize the impact of bison depopulation on other wildlife populations. The following four should be considered fully.

(1) Slaughtering operations should be conducted mostly in winter, leaving the summer as a period of natural adjustment of wolves to a lower prey base. It is expected that, by the next autumn, the wolf population will be more and less at the level that can be supported by the number of bison still present. Such a scenario would minimize interference with trapping activities in autumn, either directly (i.e., disturbance created by the slaughtering crews) or indirectly (i.e., scavenging of furbearer animals caught in traps by food-stressed wolves).

(2) An effort should be made to avoid discarding bison remains in the field during slaughtering operations. This practice would reduce scavenging by wolves, and would favour a more rapid adjustment of wolves to a lower prey base.

(3) If fences have to be erected for the purpose of bison ranching, the design should ensure that wolves cannot enter the enclosures. Wolf-proof fences would eliminate possible conflicts between wolves and ranchers. This measure also applies to all activities of bison husbandry within the present range distribution of the wolf.

(4) Because the impact of wolf predation on moose after bison repopulation is unknown, it is recommended that tri-annual moose surveys be conducted during the bison depopulation-repopulation programme. The objectives of such surveys should be

to monitor changes in moose density and calf:cow ratio in early winter. The possible impact of displaced wolf predation on moose, because of a greater abundance of bison in forested areas, should be considered seriously by managers as the Indian people rely on moose for their livelihood.

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Agricultural Technical Issues for the Northern Diseased Bison Environmental Assessment Panel

Technical Review
Contractors Report
DSS File XSB89 - 00113 - (009)
KA601 - 9 - 2552/01-XSB

On behalf of Environment Canada

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1.0 EXECUTIVE SUMMARY

The potential for economic hardship to the agricultural industry arising from spread of brucellosis and tubercullosis from the Diseased Bison herd in Wood Buffalo National Park to cattle and other bison herds in Alberta and Canada is influenced by several factors. First, the growth in cattle numbers in the proximity of the Park is significant and has been encouraged through grazing reserve policy. Second, the movements of cattle between central and southern Alberta and the north, increase the risk of exposure due to widespread movements of livestock to more intensive areas. Third, the Canadian purebred cattle industry is concentrated in central Alberta and has a large economic exposure arising from any interruption in trade due to spread of disease and additional testing and quarantine.

The ideal conditions favoring agriculture with respect to the bison removal include no possibility for any contact between free roaming diseased bison and cattle populations, no special restriction on land use for cattle herd development other than rules applied to other provincial lands, no excessive competition for grazing resources and no on-going costs to maintain these conditions. Most of the options, seriously being reviewed offer less than ideal conditions and these risks are enumerated.

Under certain basic assumptions of cattle grazing density, bison:cattle ratio in an area and infection probabilities from a single contact, infection rates in the order of .02% and greater (ie. 4 out of 15,000 head) are estimated. At this order of magnitude there can be considerable concern that positive reactors could be found in the cattle populations in the area. Selection of appropriate measures to eliminate this risk will be required to adequately respond to producer concerns. This may include temporarily limiting the movement of cattle to the area while the risks remain high and until eradication is achieved.

2.0 IDENTIFYING RISKS TO THE CATTLE INDUSTRY

2.1 Industry Overview

The general trend in the cattle industry is to increasing sensitivity to the global economic developments in food production. Farm level awareness of the agricultural policies of other countries on producer income is at a high level sparked largely by the global grain wars of the 1980's and growing awareness of the impact of animal health regulations.

Compounding this changing awareness is the high rate of diffusion of technology related to the beef production sector and the consequent growth in quantity and value of trade. At the frontiers of production, processing and marketing are developments which produce or promise significant productivity increases.

Genetically, the enhancement of production has been assisted by reproduction technology including embryo transplantation, semen storage and rapid transportation. Genetic selection through private and government performance recording systems has enabled some sectors of the industry to make progress much more rapidly than what may be observed in the national herd average over time. The result has been a tendency to higher economic value in international trade for seed stock.

Canada appears to be well positioned to continue to capture many international opportunities provided that barriers to trade (such as disease and health regulations) can be overcome and current markets retained.

The commercial beef sector, relying on genetic and other technological improvements, has become focused on international, high value markets such as Japan, the U.S. and Europe. This segment of the agri-food complex is one of Western Canada's most immediate economic prospects. However, the industry, faced with recovery from climatic and marketing problems over a decade, has only recently begun to attract new investment and begin herd rebuilding. The financial stability of the industry appears to be vulnerable to any factor that might indicate loss of confidence by the banking sector. The interruption, even temporarily, of trade at the seed stock or commercial beef level, will create widespread difficulties for producers, processors and related service industries.

Domestic movements of cattle over long distances have become pronounced with upgraded roadways and efficient truck transportation. Although the live fat cattle movement appears to be stagnant or declining due to rationalization in the feeding and packing industry, the movements in feeder cattle and breeding stock are up due to annual movements between winter and summer locations. This is a result of increasing specialization of production and marketing, concentration of grazing activity in public reserves and private land, the

increased cost of grazing land and the impacts of drought conditions in the southern prairies.

Projected "green house" weather and climatic variations affecting cattle production and movement patterns suggest that cattle producers will become increasingly dependent on forage sources from the northern prairies or irrigation in the south. These effects may be minimized through genetic and technical enhancements on the existing agricultural land base.

Intensified production, whether in feedlots or through "cell grazing" methods, shows promise of greater efficiency of resource use. However, this concentration of cattle suggests a diseased animal could be exposed to greater numbers over a shorter period of time thus increasing the risks of spread of infection. Some advantages of closer supervision by producers allow quicker isolation and treatment of diseased animals but there is little evidence to suggest that cattle populations are more healthy in such an environment. In fact, concerns by many producers relate to the periodic disease "storms" which can significantly affect intensive beef operations.

The cyclical depopulation and repopulation in the cow herd had declined in 1988 to the lowest level in 30 years. Depending upon economic conditions and feed costs, cattle herds appear poised for expansion in the prairies. This creates the possibility of a more active trade in seed stock and a search for grazing lands which can be justified on a marginal cost basis. The demand for public grazing reserves will increase and an obvious source of land appears to be in northern Alberta and Saskatchewan. Much of the former grazing land in the southern prairies will not likely be returned to grass if grain production is viable or supported by government payments. The potential for increased conservation set aside or potential return to more grazing is dependent upon new public initiatives which are inconsistent with fiscal restraint in the foreseeable future.

3.0 STRUCTURAL ISSUES IN THE ALBERTA INDUSTRY

The livestock industry is heavily concentrated in Alberta, the area most closely associated with the Wood Buffalo National Park (WBNP) diseased bison herd. In the Alberta cattle industry, plentiful and inexpensive grass pasture leases are invaluable resources for farmers and ranchers. The use of pasture provides a lower cost of gain for lighter- weight feeders and a method by which cows and calves may be maintained over spring and summer months. Government grazing reserves provide additional pasture to ranchers who do not have access to the quantity of pasture they require within their operations.

The cattle populations most affected by the presence of diseased bison may be those involved in public grazing reserves where the movements from winter feeding areas to summer grazing are substantial. These also appear to be increasing in size and number as grazing availability on private lands and in other parts of the province are more limited.

Many of the current 32 grazing reserves in Alberta were established with assistance of the Alberta Government Heritage Savings Trust Fund. With planning of these particular reserves beginning in the mid-seventies, all were operational by 1985 with the exception of the Sang Lake Grazing area in West Central Alberta. This reserve was under development in 1985 but opened in 1986. The Heritage Fund was particularly successful in establishing new reserves in the Grande Prairie and Peace River area with a total of seven new reserves completed within this decade. The last of these was established at Vermilion and completed in 1987. Government reserves are distributed within the province through three major geographic areas:

a) Southern
b) West and Central
c) Northern

These area groupings can be seen on the map in Appendix 1. Brief comments of each area follow with more detail provided on the focus area of study in the northern part of the province.

3.1 Description and Location of Reserves

The grazing availability throughout the province is of importance in determining demand in the long run. The emphasis will, however, be on the northern reserves.

3.1.1 Southern

This area includes pasture composed largely of prairie grasslands in the Lethbridge and Medicine Hat regions. Each region has administrative control over four grazing reserves as follows:

Lethbridge	Medicine Hat
Lonesome Lake	Bow Island
Hays	Pin Horn
Purple Springs	Sage Creek
Twin River	Seven Persons

In 1988, these two regions accommodated grazing for almost 23,000 head or 23% of the total grazed on government reserves that year. For the longer established reserves in the area, seasonal grazing has remained fairly consistent, but in total, has increased with the addition of a new reserve at Hays. On the whole, low rainfall during the summer months has restricted any increases in grazing numbers within the entire southern area.

3.1.2 West and Central

Beginning northwest of Red Deer through to the northeast of the province at Cold Lake, there are three regions of grazing administration with each of the separate reserves as follows:

West-Central	Edmonton	St. Paul
Buck Mountain	Black Bear	Minburn
Jack Pine	Connor Creek	Rannach
Medicine Lake	Thorhild	St. Paul
Pembina		Smoky Lake
Rocky Mtn. House		Wolf Lake
Sang Lake		

These three grazing regions provided pasture for 47,720 head or 47% of all cattle grazed on public reserves in 1988. With the exception of Sang Lake, all reserves in this area have been established prior to 1986. Historically, cattle numbers were relatively stable between 1984 and 1986 but showed increases of approximately 3,000 head due to the establishment of reserves at Pembina in 1985 and Sang Lake in 1986.

3.1.3 Northern

This area includes the Grande Prairie and Peace River regions with reserve area totalling 123,300 and 77,500 acres respectively. However, allowance must be made for the fact that some reserves have high amounts of

treed and densely-brushed areas. For example, the reserve of Three Creeks with total acreage of 39,500 is estimated to have only 30% of its area usable for grazing purposes.

The individual reserves are identified below by region:

Grande Prairie	Peace River
Bear Canyon	Fort Vermilion
Blueberry Mountain	High Prairie
Keskin Lake	Manning
Valleyview	Three Creeks
Wanham	Whitemud

Although grazing numbers have generally increased steadily, the Grande Prairie region recorded a slight drop in numbers grazed between 1987 and 1988. In 1987, 15,135 head were on the reserves compared with 14,674 in 1988. Grazing numbers have increased steadily although the drought conditions in central and southern areas temporarily accelerated the growth rate.

Table 3.1

CATTLE ON NORTHERN GRAZING RESERVES
PEACE RIVER AND GRANDE PRAIRIE REGIONS

1982 - 1988

	Peace River	Grande Prairie
1982	5,116	10,468
1983	9,079	11,679
1984	12,004	13,225
1985	16,113	16,043
1986	13,545	16,004
1987	12,742	15,017
1988	16,437	14,674

The Peace River reserves are widely dispersed, with the southern one at High Prairie and the most northern at Fort Vermilion some 320 km. away. Since 1983, this region has experienced large cattle grazing numbers in part due to a form of provincial transportation subsidy initiated for the Fort Vermilion reserve. In 1988, in the Peace River region there was a significant increase to 16,437 head from the 12,742 head in 1987. Attractive grazing rates, which offset transportation costs are cited, as a significant factor in this increase of grazing populations, particularly in the Fort Vermilion reserve.

The Grande Prairie and Peace River regions together provided grazing for a total of 31,111 head in 1988 or almost 31% of the Alberta numbers. This compares with 27,877 head in 1987 or 28% of the total. Under these conditions there appears to be good demand for grazing acreage in the north once the reserves become operational. Some planners had originally advocated expansion of existing reserves such as the Whitemud in the Peace River region or Wanham lands in the Grande Prairie region at the time of planning for new reserves with assistance of the Heritage Trust Fund in the mid-seventies.

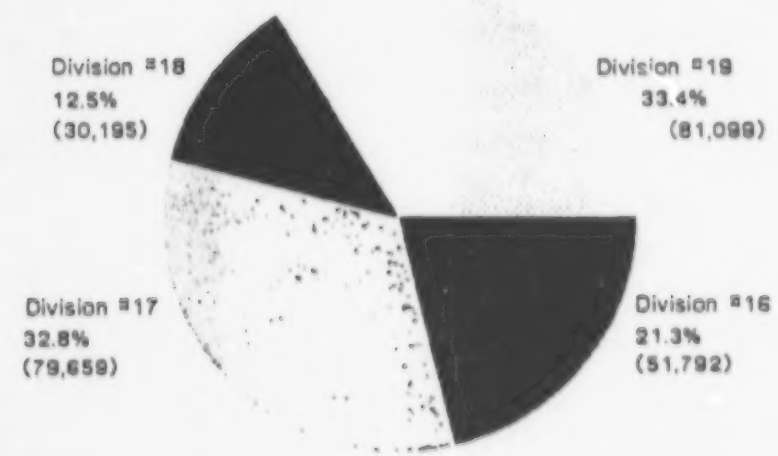
3.2 Privately Owned Grazing Populations

Statistics collected from the 1986 census on privately owned cattle in northern regions indicate that substantial numbers existed at the time. The results are shown below in Figure 3.1.

Figure 3.1

Cattle Population in Northern Alberta
By Division, 1986

Source: Statistics Canada



The figure shows the population of all cattle and calves, including registered cattle and bulls for the four divisions even though no public cattle are in the proximity of the Wood Buffalo National Park. This area represents a total of 242,745 head or 7.1% of the provincial total in 1986. The Peace River region, in particular, is experiencing changes in several of the factors which affect the cattle populations in the area.

The first factor is the on-going clearing of land approximately 16 kilometers on either side of Highway 35, north of Manning to Fort Vermilion. Although settlements have been located in the area for at least 40 years, recently there has been an increase in activity and settlement due to logging activity and related farming opportunities. Second, climatic conditions in all areas of the province in recent years have forced movements of cattle northward from central Alberta for summer grazing. Regional managers can accommodate only a limited increase in cattle numbers because the northern area has also experienced some drier periods. Third, a substantial amount of expansion is occurring in the La Crete area, south of Fort Vermilion. Communities in the area include significant numbers of beginning farmers in the 18-22 year age bracket who, combined with others in the area, are expected to continue the clearing and settlement process.

Preliminary analysis indicates cattle numbers in the area to the west of Wood Buffalo National Park at approximately 2,500 head are distributed among 90 herds from High Level east to the Park boundary. The area east of Fort Vermilion to the national park itself is estimated to include 300 head in 10 herds. These populations are primarily located in the Peace River drainage basin. Expansion in these areas is likely given a general increase in the national cattle herd.

3.3 Cattle Grazing Assistance

A significant factor influencing the seasonal cattle populations in northern Alberta was the introduction of a form of cattle grazing subsidy in the 1984-86 period. The subsidy was evident in the grazing rate (AUM) charged by reserve administration adjusted for hauling distance. One animal unit is deemed to be a 1000 lb. cow with or without a calf at side. Yearlings are rated at .75 of an animal unit and bulls at 1.5 animal units. Under the program, an owner with a minimum of 240 kilometers travelling distance to a reserve and up to 720 kilometers qualifies for a deduction of his grazing rate. Within the qualifying distance the rate is reduced by 62.5 cents per kilometer per AUM up to the 720 kilometer limit. This allows a maximum of $3.00 subsidy per AUM. The Lands Branch of Alberta Lands & Forests establishes the base rate on a number of factors intended to reflect economic rent.

In 1988, 574 cattle in the Fort Vermilion reserve qualified for the full discount with the remainder expected to have received partial discounts.

To demonstrate the impact of the subsidy, a calculated mileage was obtained for an owner shipping a semi-trailer load of cattle to the Fort Vermilion reserve. Assuming he is eligible for the maximum deduction of $3.00/AUM (over 720 kilometers land), for 4 months of grazing the economic benefit of the subsidy is $12/AUM over the grazing season. A semi-trailer carrying, for example, a total of 40 head of cows per load, would benefit by a total of $480 per year. The $480 benefit is then divided by the cost of transport at $1.87 per kilometer yielding an effective impact area of 255 kilometers radius from the Fort Vermilion Reserve. On these assumptions, the effective area is shown in Figure 3.2.

A more likely case is a situation whereby a cattle producer would transport yearling cattle to the grazing reserve. The effective area would be realized based on the fact that a yearling equals .75 AUM, and more assistance would be available. Using an assumed figure of 70 head per load, the effective area is as follows:

(70 head x .75 x $12/AUM)/$1.87 per kilometer = 336 kms

This radius is shown on the map in Figure 3.2.

The subsidy was targeted at increasing grazing populations at the Fort Vermilion reserve. This reserve experienced a steady increase in cattle numbers from just 293 head in 1982 to 2,395 head in 1988 (See Table 3.2). Ranchers were apparently responding to the subsidy by moving the cattle further north to Fort Vermilion in larger numbers than ever before illustrating the impact of grazing costs on movements. This data indicates that any subsidy in the future should be expected to increase grazing populations in a similar manner. As of 1989, the subsidy has been withdrawn and all cattlemen are being charged the normal grazing rate. It is anticipated that no subsidies will be offered in the foreseeable future although the issue may be reviewed on a year by year basis. Regional managers suggest that patrons are impressed with the service and will send cattle north in future years without subsidy once they have become dependent upon this grazing source.

Figure 3.2

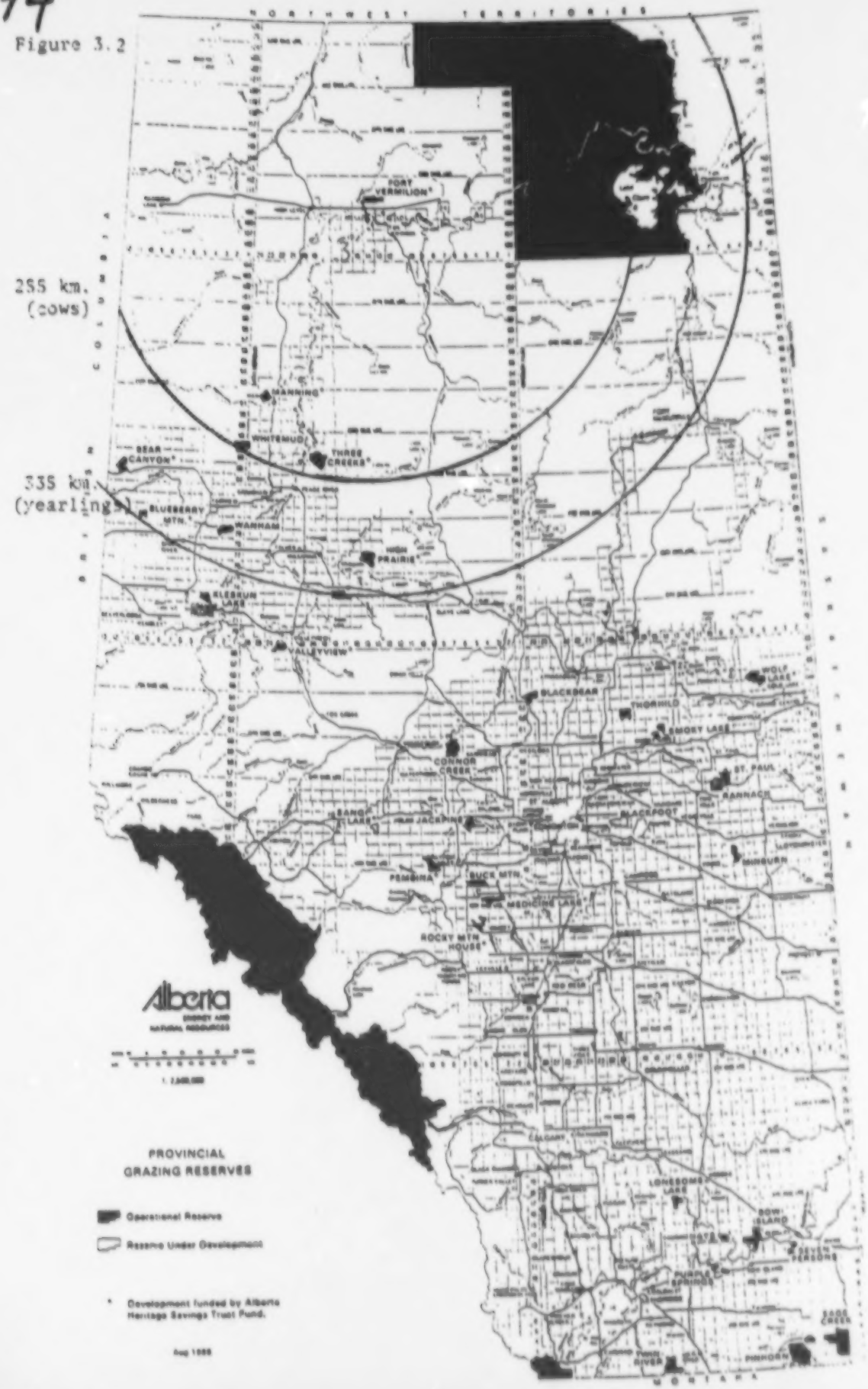

255 km.
(cows)
335 km.
(yearlings)
NORTHWEST TERRITORIES
FORT VERMILION
MANNING
WHITEMUD
THREE CREEKS
BEAR CANYON
BLUEBERRY MTN.
WARNHAM
PRAIRIE
KLESKUN LAKE
VALLEYVIEW
BLACKBEAR
THORHILD
SMOKY LAKE
WOLF LAKE
CONNOR CREEK
ST. PAUL
BANNACK
BLACKFOOT
SANGUDO
JACKPINE
PEMBINA
BUCK MTN.
MEDICINE LAKE
ROCKY MTN. HOUSE
SIMBURN
LONESOME LAKE
BOW ISLAND
PURPLE SPRINGS
MONTANA
Alberta
ENERGY AND NATURAL RESOURCES
PROVINCIAL
GRAZING RESERVES
Operational Reserve
Reserve Under Development
* Development funded by Alberta Heritage Savings Trust Fund.
Aug 1988

Table 3.2

GRAZING POPULATION AT FORT VERMILION

1982 - 1988

	Number of Head
1982	293
1983	851
1984	871
1985	1,381
1986	1,917
1987	1,866
1988	2,395

Source: Alberta Lands, Forestry and Wildlife

In northern grazing areas, in particular the Peace River region, cattle transport and movement has played a key role in maintaining the greatest possible use of grazing reserves. Most northern area ranchers who required it had access to public grazing leases within the 240 kilometer minimum qualifying distance. This dictated that many of the cattle intended to be moved to Fort Vermilion would originate from points south of Edmonton.

Since most cattle owners reside south of Edmonton and outside the 772 kilometer limit, the full amount of subsidy, a $3.00 discount per AUM, was realized. To operate the Fort Vermilion reserve on an economic rent basis, a gross rate of $7.80/AUM was charged leaving the producer with costs of $4.80/AUM after the subsidy in addition to transport costs. This can be compared to central and southern Alberta rates of $12 to $20 per AUM during 1989.

Department Sources estimate that up to 60% of all cattle grazed in the Peace River region originate in the Edmonton area. Estimates of another 1,000 - 2,000 head move north, largely into the Three Creeks reserve from the Calgary area and south. This estimate is largely confirmed by increases in the Three Creeks animal grazing populations. From just 673 head in 1982 to 3,244 in 1986 and to 4,245 in 1988, the use of this reserve has expanded greatly. However, in many cases, it becomes difficult to determine the degree to which subsidies, climatic conditions and expanding pasture availability all influence annual populations on the grazing reserves.

Within the Grande Prairie region there are several large cattle herds and their numbers greatly influence populations grazed in the region. Very few numbers of cattle on grazing reserves originate from south of Valleyview.

The consequence of moving cattle from central Alberta, a center of high concentration of commercial and purebred herds, to northern Alberta near the diseased bison, significantly increases the risk of disease transmission widely throughout the cattle population.

3.4 Purebred Cattle in Alberta

One of the major issues revolving around the diseased bison problem is the fear expressed by cattlemen of herd infection with brucellosis and/or tuberculosis. Export of live cattle and semen are controlled by the disease free status required of all herds and negative test on all sales animals. Though it is not likely producers would ship purebreds to reserves in the north, disease contraction is possible through the commercial cattle owned and sent to grazing in the north in high risk areas. Alberta has a high concentration of the Canadian purebred herd. Most beef breeds indicate at least one-third of their herd book registries originating in Alberta with some of the newer breeds approaching 80% of their numbers in the province. In many of these operations the herds are not co-mingled with commercial cattle but common fences and wintering facilities are involved. Increased leasing and return of bulls is prevalent as well.

The concentration of purebred beef cattle within the province is generally centered in the parkland area extending from north of Calgary to south of Edmonton, east to the Saskatchewan border and west to the foothills. This area is also the source of significant numbers of commercial cattle moving to northern grazing reserves and there is potential for infected individuals to return to this highly concentrated area with extremely severe economic loss implications.

Numbers for northern Alberta from census divisions 16-19 indicate purebred cattle and calves totalled 15,970 head for these divisions in 1986, and at an estimated average of 50 head per operation, this would constitute about 300 herds. Table 3.3 shows the numbers of purebred cattle in the province.

Table 3.3

Registered Cattle and Calves in Alberta
1986 Census Results

Census Division	Farms	Registered Cows and Calves
1	386	8,546
2	631	14,326
3	591	19,744
4	479	10,705
5	644	15,872
6	1,184	37,824
7	1,093	28,305
8	1,181	32,426
9	341	6,769
10	1,634	35,161
11	1,588	30,013
12	531	6,832
13	1,399	21,267
14	222	2,554
16	199	1,691
17	448	5,331
18	159	2,043
19	492	6,905
Total	13,202	287,314

Source: Statistics Canada Census, 1986

3.5 Export Sales

Due to the possibility of disease contraction in purebred herds, cattlemen are concerned about potential damage to the purebred export industry. Statistics on live sales to major purchasers were compiled for 1984 through to 1988 and shown in Table 3.4.

The most current data available as of mid 1989, indicates Alberta sales of $3,000,000 already equalling the total sales of 1986 and 1987. Although only 32% of the 1988 cattle numbers have been sold this year, over 46% of the 1988 dollar value has been achieved in the first 6 months of 1989.

In most years since 1985 total Canadian semen sales have been closely correlated with Alberta sales which average 50% of the total. Semen sales statistics were also compiled in the same manner as live sales and are shown in Table 3.5.

Statistics indicate that semen sales levels are highly variable in terms of dollar values. In Alberta, 1986 sales represent a 43% decline from 1985 with sales recovering by 57% in 1988. Similar trends are observed on a national basis with sales at the highest levels of recent years and a growth trend points to larger sales volumes ahead.

Table 3.4

LIVE PUREBRED CATTLE EXPORTS BY COUNTRY OF DESTINATION *
ALBERTA & CANADA (1984 - 1989)

		Alberta		Canada	
		#'s	$	#'s	$
1984					
	Sweden	1	6,800	1	7,000
	Japan	26	41,900	27	72,000
	Korea, South	617	611,378	617	611,000
	Argentina	1	78,526	1	79,000
	Mexico	317	660,883	396	777,000
	United States	3,544	9,090,090	6,492	13,860,000
	Other			491	998,000
	Year total	4,506	10,489,577	8,025	16,404,000
1985	Denmark	11	45,000	11	45,000
	Australia	2	5,437	4	25,000
	Argentina	3	115,770	4	124,000
	Venezuela	42	158,804	42	159,000
	Mexico	677	1,458,064	1,273	2,274,000
	United States	2,790	5,611,726	4,766	9,018,000
	Other			186	692,000
	Year total	3,525	7,394,801	6,286	12,337,000
1986	United States	1,739	2,832,670	3,349	5,681,000
	Ireland	5	22,500	5	23,000
	Denmark	3	22,700	16	82,000
	Japan	16	84,850	32	190,000
	Mexico	140	518,053	239	722,000
	Other			84	138,000
	Year total	1,903	3,480,773	3,725	6,836,000
1987	United States	1,422	2,275,521	3,400	5,845,000
	Austria	5	10,959	5	11,000
	Japan	70	122,500	70	123,000
	Colombia	29	58,000	59	98,000
	Mexico	342	587,304	683	1,117,000
	Other			107	618,000
	Year total	1,868	3,054,284	4,324	7,812,000
1988	Japan	228	353,000	383	532,000
	Colombia	28	70,000	30	79,000
	Mexico	1,299	2,116,000	1,399	2,323,000
	United States	3,700	5,082,000	7,778	9,828,000
	Netherlands	9	41,000	9	41,000
	Other			1,257	2,125,000
	Year total	5,264	7,662,000	10,856	14,928,000

* Excludes dairy cattle
Source: Statistics Canada

Although Alberta's largest seed stock buyers, are nearly always the same countries, demand is highly variable from year to year and very dependent upon the United States. Increasingly, Alberta has experienced a diminishing proportion of the semen export market. Once averaging just over 50% in 1984 and 1985, recent years show a drop in Alberta sales to 35% of the 1988 national semen export dollars. Total Alberta export sales for 1988 were $1,438,000. (These figures exclude purebred dairy semen). Whether this trend is affected in anyway by the presence of diseased bison has not been determined. However, decreasing sales tend to focus the purebred industry on all potential risks to this income source. Table 3.4 shows the highly variable nature of the purebred semen sales industry in terms of export dollars.

Table 3.5

Alberta Cattle Semen Exports*
($,000) 1984-1988

COUNTRY	1984	1985	1986	1987	1988
UNITED STATES	363	522	259	175	169
AUSTRALIA	267	314	154	296	827
NEW ZEALAND	152	201	65	64	158
UNITED KINGDOM	30	106	38	17	37
DENMARK	34	82	82	30	19
BRAZIL	0	25	0	55	0
VENEZUELA	0	0	0	0	49
OTHER	69	207	213	156	179
TOTAL	915	1,432	811	793	1,438

Table 3.6

Canada Cattle Semen Exports*
($,000) 1984-1988

COUNTRY	1984	1985	1986	1987	1988
UNITED STATES	1,132	1,121	974	1,267	1,421
AUSTRALIA	312	432	171	300	1,062
NEW ZEALAND	169	202	65	101	158
UNITED KINGDOM	40	161	55	23	344
DENMARK	36	82	197	30	19
BRAZIL	0	25	0	70	12
VENEZUELA	0	8	6	697	70
OTHER	269	532	486	504	1,136
TOTAL	1,958	2,555	1,948	2,992	4,152

* Excludes dairy sales
Source: Statistics Canada

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Stability in the purebred export market has not been characteristic throughout the 1980's. Analysis and review of the impact of the following factors would need to be completed to determine the reasons for the instability.

a) levels of domestic supply relative to foreign demand.
b) changes in desirability by foreign countries for major breed types supplied by Canada.
c) comparative prices of breed substitutes for the major domestic breeds supplied by Canada and elsewhere in the world.

4.0 QUALITATIVE EVALUATION OF PROPOSED OPTIONS

Several of the options proposed can be evaluated with respect to their qualitative aspects. Inherent in each are issues of judgement and detail which may enhance or detract from the viability of the option with respect to risks arising from potential spread of disease to cattle herds.

The current disease control environment in Canada, specifically the declaration of brucellosis free status, has increased the magnitude of potential negative impacts to arise from an occurrence of the disease in the cattle population. Trade in seed stock cattle, embryos, semen and meat products has been generated due to the relative disease free status of Canadian herds. This is two-fold in its impacts.

First, any barriers such as testing and quarantine in trade between two countries represent time costs, handling risks and threaten economic viability of the transactions. Reducing these risks through disease free certification encourages the parties to more readily consider the transaction. Second, the development of exportable genetic material requires commitment of resources and management over several breeding seasons. As well, the market development activities in anticipation of export business require considerable commitment in time and travel. Therefore, the development of an export focus by the cattle industry is dependent upon minimal risks and reduced test and quarantine costs due to health status of the country.

4.1 Ideal Conditions for Agricultural Interests

The ideal conditions for the agricultural industry with respect to the diseased bison in and around the Wood Buffalo National Park would be the following:

a) No possibility for contact between free roaming diseased bison and cattle populations.
b) No restriction of land use for cattle herd development on the provincial lands surrounding the Park.
c) No excessive competition for grazing resources where lands have been developed and designated for cattle.
d) No on-going costs to maintain the above conditions.

Any conditions less than the ideal will create risks from imperceptible to extreme. The options must be evaluated to determine the degree of risk involved in comparison to a zero risk assumed to arise from these proposed ideal conditions.

4.2 Option One: Status Quo

4.2.1 Contact Possibilities

Continuation of the current program of monitoring, occasional testing and depletion through hunting outside of the park creates contact opportunities with the cattle population. Although there is little evidence of the ex-park bison population increasing, there are reported sightings of straying bulls and herd migrations into agricultural areas. Unusual feed conditions and weather patterns occur infrequently but appear to create a degree of unpredictability to the straying and migration patterns. There is little evidence that the status quo option provides a zero contact condition. The frequency of contact is greater than zero and may vary considerably year by year.

4.2.2 Restrictions on Land Use

The relevant agencies such as Alberta Agriculture, Alberta Lands, and Agriculture Canada appear not to have restrictions on land use related to the diseased bison herd. When agricultural demand for land under established parameters has been determined, new grazing reserves or sale of crown lands appear uninhibited by the presence of the diseased bison herd. This situation results more from existing jurisdictional mandate and may not likely exist for long if the status quo were maintained.

4.2.3 Resource Competition

There has been little evidence that the status quo has created increasingly competitive conditions with respect to resource use outside of the Park. A continuation of the current hunting and herd depopulation trend would, however, raise the occurrences of bison use of cattle grazing resources.

4.2.4 On-Going Costs

The status quo option appears to have high costs associated with brucellosis testing of cattle in northern Alberta (estimated at $500,000 per year) especially when calculated on a per head basis on cattle in the immediate area and on the northern grazing reserves. The need to test cattle would continue and increase substantially when positive reactors were identified.

4.3 Option Two - Wood Bison Recovery and Disease Eradication

4.3.1 Contact Possibilities

The intensification of handling and movement of bison in this option would not appear to decrease the risk of contact with cattle herds at least in the first stages (recovery) and especially if straying and migration were not curtailed early in the plan. Once all the bison had been tested and all infected bison removed, the contact possibilities would decrease. However, the last diseased bison to be eradicated would likely be in the more sparsely populated areas further from the concentration in the Park raising concerns about potential straying into cattle grazing areas.

4.3.2 Restrictions on Land Use

The implementation of the recovery option would most feasibly be achieved with restrictions to new lands being developed for agriculture in the immediate vicinity of the park. This would require a reduction in grazing reserve development and private herd development over much of the 10-15 year implementation period.

4.3.3 Resource Competition

The recovery option would place increased pressure on areas outside of the Park where the repopulation and breeding effect was to be concentrated. Competition for winter feed may even become critical if only local sources of storable feed were considered.

4.3.4 On-Going Costs

The eventual result, if successful, should be decreased costs of testing cattle. The costs of testing in the interim would likely be increased if the cattle herds in the area were to increase in number due to failure expectations of disease eradication and land development. The costs over the 15 years and any extensions in time required due to failure to achieve zero disease levels would continue to be added to the public and possibly private costs to maintain cattle disease free.

4.4 Option Three - Fencing the Perimeter of WBNP

The qualitative merit of this option is entirely dependent upon the integrity of fencing in maintaining zero transmission. It would not achieve any of the conditions established as ideal unless this barrier was sufficient to ensure that cattle would not be at risk even while bordering the perimeter fence.

4.5 Option Four - Test and Slaughter

This option can not be assessed until the feasibility of disease eradication and the logistics of repeated handling of bison within and outside of the park could be established. The long term risks and costs to agriculture of such a program would not be lower than at present unless the effectiveness was demonstrated exclusive of complete adult herd depopulation as occurred at Elk Island National Park.

4.6 Other Composite Options

The agricultural risks and costs could be minimized and even reduced to zero if:

(1) Disease free populations could be established away from cattle and existing bison ranches.
(2) All bison in the area (including the Park) were depopulated.
(3) Feed production was derived from sources different from cattle feed supplies.
(4) The repopulation phase only commenced when there were no longer any risks of infection and the disease testing and surveillance program for cattle could be discontinued.

Future repopulation to levels of 12,000 to 15,000 head of disease free bison may create resource competition for cattle and game farming and would require additional fencing and barrier development if agricultural uses of land are to expand in the areas adjacent to the Park..

5.0 QUANTITATIVE ANALYSIS OF RISKS TO LIVESTOCK PRODUCERS

Concern has been raised by livestock producers regarding the real and perceived risks resulting from the existence of a significant pool of infected bison in the near proximity of disease free cattle herds. The objective assessment of this risk is made difficult due to several factors which, although they are key determinants of the risk, are not well documented nor easily measured.

An approach to estimating the risks involves establishing several parameters on which certain assumptions can be tested to determine the order of magnitude or relative differences between proposed solutions. The failure rates of fence structures, annual weather pattern or human error in testing or movement is not included in the calculations. Of primary concern are the risks to the cattle populations from straying bulls or herd migration patterns.

The co-existence of cattle herds and free roaming bison population creates opportunities for contact. These opportunities are affected by distances, population densities and movement speeds and patterns. Infection by one animal of others depends upon these physical contact opportunities as well as the rates or probabilities of disease transmission from each contact. The use of more elaborate analysis than that used here may refine the estimates beyond order of magnitude but is is unlikely that precision could be thorough enough to achieve a high level of actuarial soundness.

5.1 Basic Assumptions in the Calculations

Several underlying assumptions affect the results of the risk analysis. It is assumed that migration or straying patterns of bison will be directionally oriented to the extent that animals will move outward from a beginning point between two radii at 90 degrees. It is assumed that, although the actual pattern is much more defined by vegetation, rivers and other natural terrain, seasonal migrations are fairly directional. For example, if straying bulls have been reported sighted over 60 km from the herd of origin and identified as returning to the herd within one season, some evidence of linear travel is indicated. Further information on multi-year migrations and new herd formation would be required to more accurately define the distribution of current herds in the WBNP and surrounding area.

It is assumed that an even distribution of cattle herds would occur throughout the portion of a circular area within the 90 degree radius. The cattle:bison ratio assumes both cattle and bison herds are free roaming or have equal opportunity for contact within the area.

The rate of transmission of infection of either tuberculosis or brucellosis would be dependent upon many factors including

season of the year, herd sex composition and mode and level of infection in the bison herds. The calculations allow for a wide range of possible rates of transmission of disease upon contact.

Cattle populations in the vicinity of the Park (0-100 km) have been highly variable but generally appear to be trending higher. Various densities are used to determine the potential for increases in contact rate.

It must be emphasized that these calculations are illustrative of the order of magnitude of the rate of spread of infection but they are not sufficiently accurate to provide definitive probabilities or statistical validity.

5.2 Assessment of Risks

The array of possible contact and infection levels is illustrated in summary Table 5.1. For example a radially shaped area bounded by 50 km radii at 90 degrees containing approximately 7,800 square kilometers with a bison: cattle population ratio of 1:800 and medium cattle grazing density of 15,000 head (approximately 2 per square kilometer) would produce potential infection in the order of 4 to 8 head if disease transmission was probable at 20% to 40% risk at the time of contact. This equates to an incidence of .02% to .04%.

This analysis illustrates that the herds now in the area around the Park are subject to real risks and, if moved into more intensive population areas undetected, raise the possibilities of significant exposure of the provincial herds to infection. The potential economic damage to cattle herds is not significantly greater at higher rates of possible brucellosis infection. This is because the threshold level of infection required to "trigger" testing in the wider cattle populations and create export trade barriers are not affected immediately by the extent of infection only its existence..

Table 5.1

DISEASE CONTRACTION RISK ANALYSIS

Number of cattle estimated to contract disease

Area	Estimated Species Ratio	Stocking Rate	Cattle #'s	Incidence of infection upon contact 10%	20%	30%	40%	50%	60%	70%	80%	90%
10 km. or 75 sq. km.	1 : 7.5											
		Light	500	7	13	20	27	33	40	47	53	60
			2,500	33	67	100	133	167	200	233	267	300
		Medium	3,500	47	93	140	187	233	280	327	373	420
			5,000	67	133	200	267	333	400	467	533	600
		Heavy	7,500	100	200	300	400	500	600	700	800	900
			10,000	133	267	400	533	667	800	933	1067	1200
30 km. or 700 sq. km.	1 : 70											
		Light	500	1	1	2	3	4	4	5	6	6
			2,500	4	7	11	14	18	21	25	29	32
		Medium	3,500	5	10	15	20	25	30	35	40	45
			5,000	7	14	21	29	36	43	50	57	64
		Heavy	7,500	11	21	32	43	54	64	75	86	96
			10,000	14	29	43	57	71	86	100	114	129
100 km. or 7800 sq. km.	1 : 800											
		Light	5,000	1	1	2	3	3	4	4	5	6
			8,000	1	2	3	4	5	6	7	8	9
			12,000	2	3	5	6	8	9	11	12	14
		Medium	15,000	2	4	6	8	9	11	13	15	17
			18,000	2	5	7	9	11	14	16	18	20
			21,000	3	5	8	11	13	16	18	21	24
		Heavy	24,000	3	6	9	12	15	18	21	24	27
			27,000	3	7	10	14	17	20	24	27	30
			30,000	4	8	11	15	19	23	26	30	34

NOTE: The area is based on "X" km. of any two radii extended at 90 degrees from any one point of origin.

6.0 CONCLUSIONS AND RECOMMENDATIONS

The economic impacts of disruption in sales of seed stock semen and embryos can be estimated through the losses incurred from two main sources. The first source would be the inability to sell health certified cattle, semen or embryos due to either inability to pass tests or through area wide restriction should brucellosis free status be lost. The second source of loss would derive from lower foreign demand due to the perception of lower health status in Canada and particularly Western Canada. This may be reflected in volume and price and would be dependent upon the size of disease outbreak and the appropriatness of the response of regulatory authorities and producers. However, it is unlikely that the current levels of export trade would be quickly re-established with those countries which currently are brucellosis free and those which soon intend to be free.

The direct losses from a major outbreak are estimated to be up to one half of sales value over a period of 10 years. This would total in the range of $75 to $100 million based on the industry view that at least one out of two buyers would look to other countries for seed stock if disease free status was lost. Other costs including losses in market value of all herds, in re-establishing market presence and in slaughter replacement losses, would more than double the direct sales loss. This outside estimate of potential loss would most likely result if there was a failure to detect and slaughter all infected cattle within a relatively short (1 year) time period.

Estimation of the economic effects of a disease outbreak in the commercial beef sector is based on the impact which this would have on movements of live cattle and beef to United States markets. Live cattle movements would appear to be affected most with some impacts on beef products. However, the difficulty of marketing beef to the United States in an environment of broad public awareness of an outbreak in Canada would likely result in declining volumes and sales margins. Estimates of loss to the industry over a ten year period would be in the order of $200 to $500 million with a decrease in revenues of only 1-3% of gross sales. Serious trade disruption would push these losses much higher and injure the financial viability of 20,000-25,000 commercial scale beef producers in the province and elsewhere in Canada.

Recommendations:

The implications to agriculture of a disease outbreak from the bison in WBNP require consideration of the following:

(1) That any increased exposure of the cow herd to diseased bison is an unacceptable risk to the industry.

(2) That any evaluation of risk under an option where diseased bison remain, include thorough analysis of transmission rates, reliability of detection and contact frequency between bison and cattle.

(3) That thorough review of the final option selected include analysis of local opportunities and future economic viability of the private beef and bison industry as it relates to the areas in the vicinity of the Park compared with other methods of enhancing efficiencies in the industry elsewhere in the province.

APPENDIX

CATTLE ON GRAZING RESERVES
GRANDE PRAIRIE REGION, 1982 - 1988

	1982/83	1983/84	1984/85	1985/86	1986/87	1987/88	1988/89	% change 1982 - 1988
Bear Canyon								
Cows	315	460	729	761	801	886	599	
Yearlings	196	281	238	163	1,046	497	203	
Steers	347	839	1,576	2,535	854	1,789	1,482	
Calves	298	427	696	732	760	861	596	
Bulls	11	19	25	25	28	26	19	
Subtotal	1,166	2,026	3,264	4,216	3,489	4,059	2,899	148.6%
Blueberry Mtn.								
Cows	689	1,014	832	938	907	978	975	
Yearlings	104	147	177	277	129	227	253	
Steers	0	11	0	87	41	133	0	
Calves	698	931	799	892	864	932	941	
Bulls	30	36	27	32	27	26	23	
Subtotal	1,521	2,139	1,835	2,226	1,968	2,296	2,192	44.1%
Kleskun Lake								
Cows	1,083	1,102	1,316	1,097	1,181	909	1,086	
Yearlings	650	422	387	371	409	253	181	
Steers	428	224	267	600	740	91	287	
Calves	1,016	1,024	1,239	880	1,102	861	1,043	
Bulls	49	45	55	48	50	42	42	
Subtotal	3,226	2,817	3,264	2,996	3,482	2,156	2,639	-18.2%
Valleyview								
Cows	704	705	724	907	892	997	1,266	
Yearlings	40	342	259	324	174	237	243	
Steers	60	0	209	303	78	3	0	
Calves	1,205	687	688	878	834	951	1,228	
Bulls	57	42	38	37	32	34	38	
Subtotal	2,066	1,776	1,918	2,449	2,010	2,222	2,775	34.3%
Urban								
Cows	1,304	1,144	1,168	1,462	1,429	1,607	1,723	
Yearlings	435	393	374	236	1,718	434	554	
Steers	60	259	309	1,039	546	765	182	
Calves	1,205	1,069	1,069	1,356	1,302	1,521	1,642	
Bulls	57	56	54	63	60	67	68	
Subtotal	3,061	2,921	2,974	4,156	5,055	4,394	4,169	36.2%
Total	11,040	11,679	13,255	16,043	16,004	15,127	14,674	32.9%

SOURCE: Farm Land Management Branch, Livestock Utilization records

CATTLE ON NORTHERN GRAZING RESERVES
PEACE RIVER REGION, 1982 - 1988

	1982/83	1983/84	1984/85	1985/86	1986/87	1987/88	1988/89	% change 1982 - 1988
Fort Vermilion								
Cows	105	369	340	549	475	529	790	
Yearlings	84	84	197	296	372	434	768	
Steers	0	39	23	115	628	472	42	
Calves	98	343	296	400	408	403	739	
Bulls	6	16	15	21	34	28	56	
Subtotal	293	851	871	1,381	1,917	1,866	2,395	717.4%
High Prairie								
Cows	541	912	727	629	1,097	828	1,007	
Yearlings	130	684	991	2,128	745	601	976	
Steers	0	252	1,053	1,118	625	262	959	
Calves	488	841	669	589	987	475	961	
Bulls	23	31	35	34	49	41	45	
Subtotal	1,182	2,720	3,475	4,498	3,503	2,207	3,948	234.0%
Manning								
Cows	275	499	539	659	715	655	712	
Yearlings	60	160	216	372	258	154	445	
Steers	0	0	255	167	60	230	0	
Calves	252	449	515	641	688	631	696	
Bulls	11	21	22	31	29	25	24	
Subtotal	598	1,129	1,547	1,870	1,750	1,695	1,877	213.9%
Three Creeks								
Cows	267	559	1,071	1,422	1,054	1,114	1,636	
Yearlings	151	393	259	347	58	27	511	
Steers	0	515	868	1,518	890	1,401	466	
Calves	244	489	1,004	1,388	1,032	1,083	1,577	
Bulls	11	21	42	54	50	38	55	
Subtotal	673	1,977	3,244	4,729	3,084	3,663	4,245	530.8%
Whitemud								
Cows	1,076	1,035	1,072	982	1,082	1,258	1,638	
Yearlings	179	359	546	1,281	643	550	487	
Steers	0	0	216	397	498	266	262	
Calves	976	971	995	923	1,018	1,193	1,532	
Bulls	39	37	38	52	50	44	53	
Subtotal	2,270	2,402	2,867	3,635	3,291	3,311	3,972	75.0%
Total	5,016	9,079	12,004	16,113	13,545	12,742	16,437	227.7%

SOURCE: Farm Land Management Branch, Livestock Utilization records

CATTLE ON NORTHERN GRAZING RESERVES
ST. PAUL REGION, 1982 - 1988

		1982/83	1983/84	1984/85	1985/86	1986/87	1987/88	1988/89	% change 1982 - 1988
Miriburn									
	Cows	1,203	1,283	1,257	1,429	1,453	1,562	1,488	
	Yearlings	91	89	83	84	65	77	31	
	Steers	0	0	0	0	0	51	0	
	Calves	1,155	1,253	1,225	1,388	1,439	1,509	1,464	
	Bulls	37	36	38	52	51	52	47	
	Subtotal	2,486	2,661	2,603	2,953	3,008	3,251	3,030	21.9%
Ranach									
	Cows	1,558	1,630	1,751	1,872	2,206	2,255	1,623	
	Yearlings	214	225	271	299	194	122	126	
	Steers	0	0	0	0	0	59	0	
	Calves	1,462	1,559	1,674	1,786	2,104	2,150	1,573	
	Bulls	52	54	54	55	72	58	46	
	Subtotal	3,286	3,468	3,750	4,012	4,576	4,644	3,368	2.5%
St. Paul									
	Cows	1,269	1,484	1,606	1,691	1,696	1,654	1,508	
	Yearlings	294	314	271	286	262	220	209	
	Steers	0	0	0	0	0	49	0	
	Calves	1,206	1,384	1,556	1,649	1,544	1,519	1,458	
	Bulls	48	59	53	61	60	41	44	
	Subtotal	2,817	3,241	3,486	3,687	3,562	3,483	3,219	14.3%
Smoky Lake									
	Cows	537	471	615	705	856	704	518	
	Yearlings	64	118	315	298	305	337	435	
	Steers	0	0	0	0	0	38	0	
	Calves	488	460	595	675	835	634	513	
	Bulls	20	25	26	40	48	27	31	
	Subtotal	1,109	1,074	1,551	1,718	2,044	1,740	1,497	35.0%
Wolf Lake									
	Cows	511	981	947	1,260	1,355	1,445	1,482	
	Yearlings	32	44	251	217	310	175	204	
	Steers	0	0	0	0	0	44	0	
	Calves	516	920	905	1,230	1,317	1,414	1,460	
	Bulls	20	33	31	39	39	32	45	
	Subtotal	1,079	1,978	2,134	2,746	3,021	3,110	3,191	195.7%
	Total	10,777	12,422	13,524	15,116	16,211	16,228	14,305	32.7%

SOURCE: Farm Land Management Branch, Livestock Utilization records

CATTLE ON NORTHERN GRAZING RESERVES
EDMONTON REGION, 1982 - 1988

	1982/83	1983/84	1984/85	1985/86	1986/87	1987/88	1988/89	% change 1982-1988
Black Bear								
Cows	1,726	1,809	1,708	1,815	1,478	1,679	1,517	
Yearlings	379	384	291	154	280	246	250	
Steers	0	0	0	0	0	0	0	
Calves	1,618	1,757	1,681	1,673	1,444	1,615	1,498	
Bulls	58	63	47	43	37	36	34	
Subtotal	3,781	4,013	3,727	3,685	3,239	3,576	3,299	-12.7%
Connor Creek								
Cows	3,024	3,384	3,374	3,076	3,248	3,557	3,793	
Yearlings	466	599	524	447	440	519	389	
Steers	0	0	0	0	0	0	0	
Calves	2,867	3,269	3,320	2,984	3,122	3,479	3,750	
Bulls	100	98	92	87	86	91	92	
Subtotal	6,457	7,350	7,310	6,594	6,896	7,646	8,024	24.3%
Thorchild								
Cows	1,324	1,548	1,578	1,485	1,383	1,589	1,361	
Yearlings	651	366	319	426	416	334	270	
Steers	103	126	0	0	0	0	0	
Calves	1,230	1,370	1,408	1,382	1,287	1,508	1,296	
Bulls	47	42	43	42	33	37	31	
Subtotal	3,355	3,452	3,348	3,335	3,119	3,468	2,958	-11.8%
Total	13,593	14,815	14,385	13,614	13,254	14,690	14,281	5.1%

SOURCE: Farm Land Management Branch, Livestock Utilization records